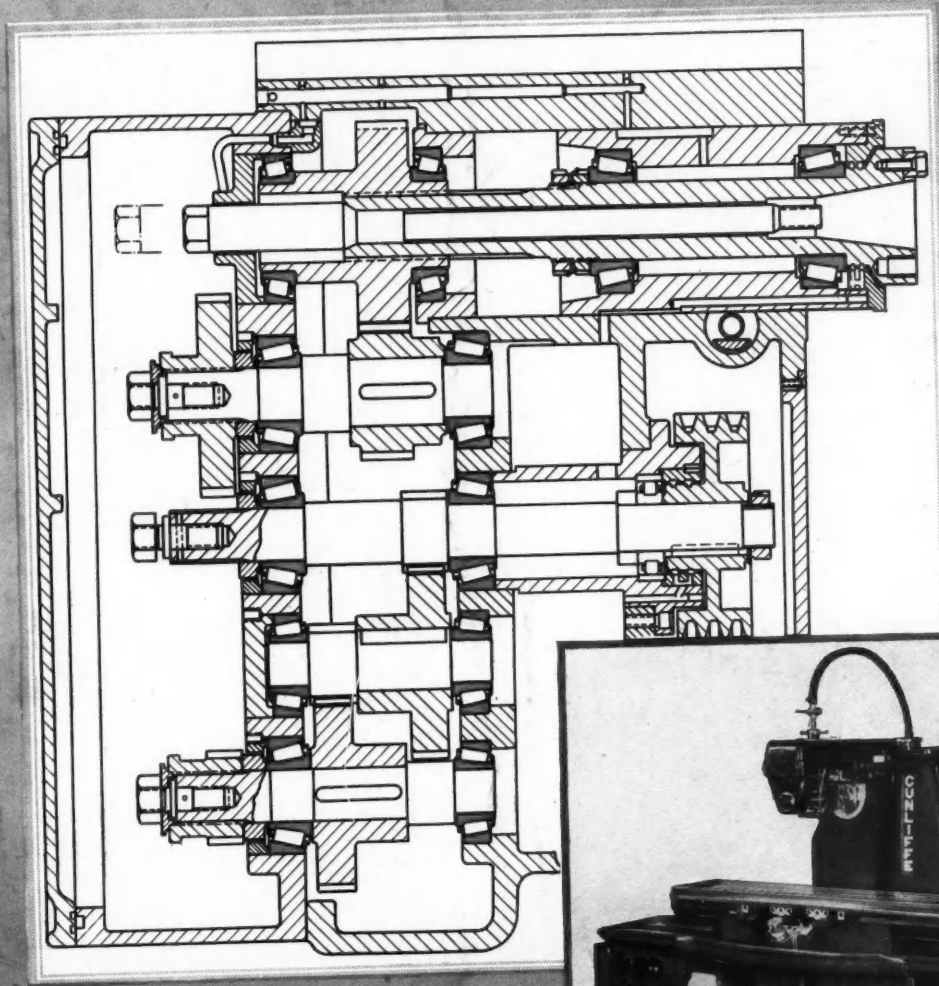
The Engineer

JANUARY 9, 1953 28, ESSEX ST., STRAND, LONDON, W.C.2 TWO SHILLINGS

UNI... OF MICHIGAN
JAN 29 1953
ENGINEERING LIBRARY



In machine tools

Here is an interesting installation of Timken tapered-roller bearings in a 20in. hydraulic production milling machine made by Cunliffe & Croom of Manchester. This is an excellent example of a well-considered layout: the main spindle is mounted in a pair of Timken bearings and extends into a splined connection with the driving gear, which is carried in its own pair of bearings. Three other shafts are each mounted in a pair of Timken bearings. The central shaft is mounted in a pair of Timken bearings which give excellent support to the gear wheel and control the end location, added support near the pulley is provided by a parallel-roller bearing. The bearings of the main spindle are adjusted by the nuts against the inboard bearing.

REGD. TRADE MARK: TIMKEN

TIMKEN *tapered-roller bearings*

BRITISH TIMKEN LIMITED, DUSTON, NORTHAMPTON; AND BIRMINGHAM

Telephone: Northampton 4921/8 Telegrams: Britimken Phone Northampton

SUBSIDIARY COMPANIES: FISCHER BEARINGS CO. LTD., WOLVERHAMPTON; TIMKEN-FISCHER STOCKISTS LTD., BIRMINGHAM

UNIQUE HICO ADVANTAGES

Confirmed by many Repeat Orders!...

Photographs by courtesy of Messrs. Henry Boot & Sons Ltd., Sheffield

HICO Centering consists of lattice girder units of various lengths which, when assembled, are pre-stressed by means of turnbuckles on the lower boom—pre-stressed to ensure a perfectly level span after the load has been added. HICO is light in weight and easy to handle by unskilled labour . . . it is adaptable to any size of span and every type of ceiling . . . its large weight carrying capacity eliminates the need for props and no load is therefore imposed on lower floors . . . it offers outstanding economies on many forms of construction.

Write for Publication BK-149

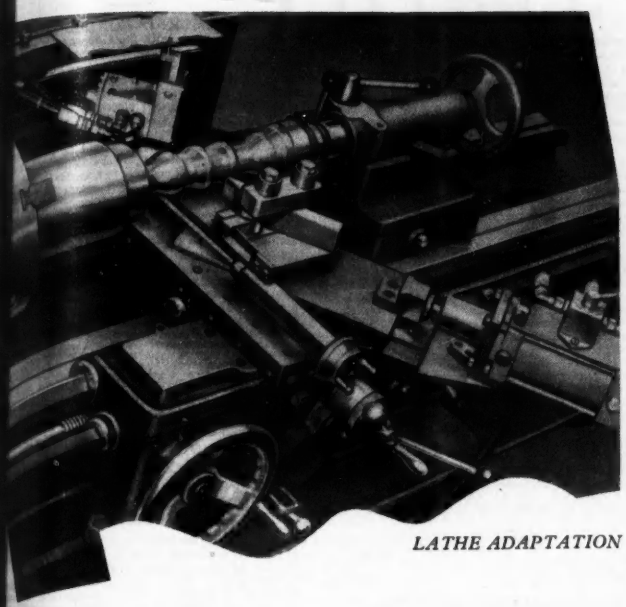
BK48

HICO offers an entirely new cost-reducing technique in barrel arch roofing & flooring

– Full details supplied on request

BLAW KNOX LTD 90/94 BROMPTON ROAD, LONDON, S.W.3

ydraulic Profiling . . .



LATHE ADAPTATION

r speed and accuracy

The Metrovick Hydraulic Single-Dimensional Profiling System is suitable for about 90 per cent of profile machining operations

Metropolitan-Vickers produced the first all-British Electronic Two-Dimensional Profiling Equipment to be manufactured in this country. And now the Metrovick Hydraulic Profiling System has been developed and can be applied to the great majority of profile machining operations.

This inexpensive hydraulic stylus-controlled equipment can be adapted, in most cases, to suit existing machines when shapes may be machined quickly in accordance with the profile of a master template or sample workpiece. The accuracy obtained is independent of the skill of the operator.

The equipment is available in a variety of forms and sizes for both new and existing machines such as lathes, milling machines, boring mills and planers.

Send for descriptive leaflet 342/32-1

METROPOLITAN-VICKERS ELECTRICAL COMPANY LIMITED TRAFFORD PARK, MANCHESTER 17

METROVICK *Member of the A.E.I. group of companies.*

Profiling systems for machine tools

G/A 102

THE ENGINEER

ESTABLISHED 1856

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JANUARY 9, 1953

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NOTICE TO READERS

All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

SUBSCRIPTIONS

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WORDING OF ADVERTISEMENTS: Approximately the first 25 letters of each advertisement are set in heavy type. Advertisers are therefore advised to begin their advertisements with the words they want emphasized.

Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

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PUBLIC APPOINTMENTS

UNIVERSITY OF NATAL, DURBAN, SOUTH AFRICA

DEPARTMENT OF ELECTRICAL ENGINEERING

SENIOR LECTURER

Applications are invited for the post of SENIOR LECTURER in the Department of Electrical Engineering.

Duties will commence on 1st August, 1953, and the post will be temporary for the period 1st August to 31st December, 1953, after which it becomes permanent.

Salary scales :

For period 1st August to 31st December, 1953, £550 by £25 to £725 p.a., plus £100 cost-of-living allowance.

Thereafter, £600 by £25 to £900 p.a., plus cost-of-living allowance of £320 for married men and £100 for single persons.

Further particulars and information as to the method of application should be obtained from the Secretary, Association of Universities of the British Commonwealth, 5, Gordon Square, London, W.C.1.

The closing date for the receipt of applications in London and South Africa is 1st February, 1953.

E6847

HUDDERSFIELD TECHNICAL COLLEGE

Principal : Dr. W. E. SCOTT, M.B.E.

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

LECTURER

Applications are invited for the full-time post of LECTURER in the Department of Civil and Mechanical Engineering. Applicants should possess a Degree or equivalent qualification, should have had experience in industry, and should preferably be Corporate Members of the Institution of Civil Engineers. The duties will involve the teaching of civil engineering subjects in day and evening classes up to the standard of B.Sc. (Eng.) and Higher National Diplomas and Certificates, and should commence as soon as possible.

Salary in accordance with the Burnham Scales for Lecturers, viz., £940 by £25 to £1040.

Further particulars and forms of application may be obtained from the Principal, Technical College, Queen Street South, Huddersfield, to whom they should be returned without delay.

H. KAY,
Chief Education Officer.

E6855

MIDDLESBROUGH EDUCATION COMMITTEE

CONSTANTINE TECHNICAL COLLEGE

Principal :
D. A. R. CLARK, M.Sc. (Tech.), M.I.Mech.E.

LECTURER

Required, as soon as possible, LECTURER in the Department of Structural Engineering and Building to teach civil and structural engineering subjects, in particular structural design in steel or reinforced concrete. Ability to teach higher surveying and or geology would be an advantage.

Burnham Technical Scale salary, £940 by £25 to £1040.

Forms and particulars obtainable from Director of Education, Woodlands Road, Middlesbrough. Applications should be returned by 26th January, 1953. E6790

THE COLLEGE OF AERONAUTICS

DEPUTY HEAD OF DEPARTMENT OF AIRCRAFT PROPULSION

Applications are invited for the post of DEPUTY HEAD OF DEPARTMENT OF AIRCRAFT PROPULSION. Candidates should have good academic qualifications and recent experience of modern aero-engine developments. The successful candidate will be required to assist the Head of the Department in organising instruction, directing research and controlling staff. In addition, the post demands specialised knowledge of project design. Some experience of vibration and stressing, or allied subjects an advantage. Present salary is up to £1400 per annum, with superannuation and family allowances, but an extension of the scale to £1600 per annum is under consideration. Modern house available.—Applications, with names and addresses of not more than three referees, to the Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks. Further particulars available if required. E6736

LEAVESDEN GROUP HOSPITAL MANAGEMENT COMMITTEE

GROUP ENGINEER

GROUP ENGINEER (resident) required. Salary £750 by £25 (3) by £30 to £855 per annum. National Health Service conditions. To be responsible for the group engineering services, plant, records, &c., and to be directly in charge at one hospital. Higher National Certificate in Mechanical Engineering or equivalent. Electrical experience essential.

Applications, stating age, training, experience and qualifications, together with the names of two referees, to the Group Secretary, Leavesden Hospital, Abbots Langley, Watford, Herts, by 21st January. E6804

LEICESTER NO. 3 HOSPITAL MANAGEMENT COMMITTEE

HOSPITALS ENGINEER

Applications are invited for the post of HOSPITALS ENGINEER for the group of hospitals controlled by the Management Committee. Applicants should have served an apprenticeship in mechanical engineering, be capable draughtsmen, and hold a recognised engineering qualification. They must have a sound knowledge of the efficient operation and maintenance of steam boiler plant, electrical generation and distribution, and of engineering services generally as applied to a large hospital. Salary will be in accordance with the Ministry of Health Scale, viz., £750–£855 per annum. The post is superannuable and a house is available upon a service tenancy. Forms of application can be obtained from the undersigned on the receipt of a stamped addressed envelope.

H. PAGE,
Secretary.

The Towers Hospital,
Leicester. E6828

KENT COUNTY COUNCIL

BUILDINGS DEPARTMENT

ENGINEERING ASSISTANT (HEATING AND MECHANICAL)

Applications are invited for the appointment in the Buildings Department of an ENGINEERING ASSISTANT (Heating and Mechanical) at a salary in A.P.T. Grades I–III (£465–£570).

Applicants must be capable draughtsmen with practical experience in heating, hot and cold water supplies and ventilation work, and should preferably have passed Sections A and B of the Examination for Associate Membership of the Institution of Heating and Ventilating Engineers. The commencing grade and salary will be dependent upon qualifications and experience.

Applications, on forms obtainable from the County Architect, Springfield, Maidstone, must be delivered to him within fourteen days of the appearance of this advertisement.

W. L. PLATTS,
Clerk of the County Council.

County Hall, Maidstone,
22nd December, 1952. E6846

COLNE VALLEY SEWERAGE BOARD

STAFF OF THE CHIEF RESIDENT ENGINEER (SEWERS)

Applications are invited for the following appointment to the above staff for the supervision of sewer contracts in Hertfordshire :—

JUNIOR ENGINEERS (Sewers), salary scale £6–£10 10s. per week.

Duration of appointment 2 to 2½ years, subject to a month's notice on either side. Salaries within the above scale to depend on experience and qualifications. Car allowance payable in approved circumstances. Housing at economic rent will be available.

Applicants should have civil engineering training of University or equivalent standard, and experience of civil engineering and setting out.

Applications, endorsed " Junior Engineer," giving full particulars of age, qualifications and experience, also the names of persons to whom reference can be made, should reach the undersigned not later than 23rd January, 1953.

Messrs. SANDFORD FAWCETT and PARTNERS.

83, Victoria Street,
London, S.W.1. E6876

THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION

PLANT ENGINEERING DIVISION

ENGINEER

ENGINEER required by the above Association for the post of Superintendent in Charge of the Plant Engineering Division, the work of which includes experimental and observation studies in works, and the determination of the fundamentals of the design of plant and equipment for the iron and steel industry.

Candidates should have a good Degree in Engineering, preferably Mechanical. Experience in the iron and steel industry, and also some administrative experience desirable. Starting salary from £1450 per annum upwards according to age, qualifications and experience. Post is superannuated under the F.S.S.U.; location of work London.

Written applications only, quoting " Plant Engineering," to the Personnel Officer, B.I.S.R.A., 11, Park Lane, W.1. E6845

BRITISH RAILWAYS

LONDON MIDLAND REGION

WORKS SUPERINTENDENT

WORKS SUPERINTENDENT, to take control of shops producing precast reinforced concrete articles, fabricated steelwork and joinery work and plant repair depot. Payment by results scheme in operation. Applicants should have a sound knowledge of planning and production methods. Practical experience in the manufacture of reinforced concrete units and the fabrication and welding of steelwork desirable. Commencing salary £1000 per annum.—Applications to be sent to the Civil Engineer, British Railways, London Midland Region, Euston, London, N.W.1, with details of past experience. E6784

COLNE VALLEY SEWERAGE BOARD

MECHANICAL AND ELECTRICAL ENGINEER

Applications are invited for the appointment as MECHANICAL and ELECTRICAL ENGINEER in the Department of the Chief Engineer to the Board at a salary of £950, rising by annual increments of £50 to a maximum of £1100 per annum.

The position is an important one and carries responsibility for the running and maintenance of all plant and machinery at a large new sewage disposal works near Rickmansworth, Herts. The whole of the plant is of the most modern type, and includes a power-house (six 750 H.P. diesel/gas convertible engines, six 750kVA. alternators, switchgear, turboblowers, &c.), four pumping stations, sludge conditioning and filtering and drying or incineration plant, horizontal and circular tank scrapers, workshops and auxiliary plant.

The works may be visited by arrangement with the Chief Engineer (Telephone, Rickmansworth 3603).

The appointment is subject to one month's notice on either side and also to the provisions of the Local Government Superannuation Acts. The successful applicant will be required to take up his duties at the earliest possible date. Housing accommodation might be made available for a limited period if necessary.

Applicants must be Corporate Members of the Institution of Mechanical or Electrical Engineers or possess other qualifications or experience acceptable to the Board. Applications from Ex-Officers of H.M. Forces with suitable qualifications and/or experience will be considered.

Applications, endorsed " M. & E.E.," with full particulars of age, qualifications, experience, &c., and the names and addresses of three persons to whom reference can be made, should reach the undersigned by not later than Saturday, 7th February, 1953.

JOHN A. LONGMORE,
Clerk of the Board.

20, Castle Street,
Hertford, Herts. E6877

GOVERNMENT OF KUWAIT

DIESEL POWER MAINTENANCE ENGINEER

DIESEL POWER MAINTENANCE ENGINEER required for services with the Government of Kuwait, Persian Gulf. The minimum technical qualification required is the Higher National Certificate in Mechanical Engineering or its equivalent, and age should be from 30 to 35 years. Applicants should have had good experience in diesel generating stations in an administrative position, and be capable of supervising maintenance and operating the station at the highest possible efficiency. Applicants must have some electrical knowledge and experience of some steam power plant would be advantageous, as at a later date the steam power station is to be commissioned and, if suitable, a transfer could be arranged. The salary offered is up to £1650 per annum, according to experience. Free furnished quarters and free medical attention are provided. The first year will be probationary and home leave will be granted at the end of two years' service. Married accommodation cannot be promised during the first year of service.—Applications, stating age and giving full details of experience, should, in the first instance, be addressed to the Secretary, Ewbank and Partners, Limited, 10/11, Grosvenor Place, London, S.W.1. E6727

LONDON ELECTRICITY BOARD

FINSBURY/SHOREDITCH DISTRICT

ENGINEER (OPERATION AND MAINTENANCE)

Applications are invited for the above position in the Finsbury/Shoreditch District of the Northern Sub-Area.

Applicants should have had a sound technical education up to at least Higher National Certificate standard, preferably being Corporate Members of the I.E.E., and possess a practical experience of all branches of engineering work associated with the organisation of a district distribution department, particularly in regard to mains and substation work on both A.C. systems (single and three-phase) and D.C. systems.

The post is graded under Schedule " A " of the National Joint Board agreement as Class E, Grade 7, £681 9s. per annum, rising to £715 1s. per annum, inclusive of London allowance.

Application forms obtainable from Establishments Officer, 46, New Broad Street, E.C.2, to be returned completed by 24th January, 1953. Please enclose addressed envelope and quote Ref. V/1565/EE. on all correspondence. E6848

MINISTRY OF LABOUR AND NATIONAL SERVICE

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

EXPERIMENTAL OFFICER (UNESTABLISHED)

Department of Scientific and Industrial Research requires EXPERIMENTAL OFFICER (Unestablished) at Fuel Research Station, Greenwich, for supervision of operation of standard carbonising and water-gas plants, steam boilers, gas-electric generating plant and pilot-scale chemical engineering plant. Pass Degree or H.N.C. in Mechanical Engineering or A.M.I. Gas Eng., preferably with experience of gas-making and purifying equipment. Min. age 26. Salary in the range of £628–£786.—Forms from M.L.N.S., Technical and Scientific Register, Almack House, 26, King Street, London, S.W.1, quoting Ref. C 754/52A. Closing date 31st January, 1953. E6834

PUBLIC APPOINTMENTS

GOVERNMENT OF KUWAIT

DIESEL POWER STATION SHIFT ENGINEER

DIESEL POWER STATION SHIFT ENGI... required for service with the Govern... Persian Gulf. Applicants should have some ... qualification and should not be more than 35 ... age. He should have good experience in the o... and maintenance of diesel engines and ... and also have sufficient electrical knowledge ... A.C. distribution system to be able to operate ... power plant in the station efficiently. Steam ... plant operation experience would be advanta... as at a later date a steam power station will be co... ing, and it might be possible to transfer the ser... the diesel power station shift engineers over ... steam station. The starting consolidated ... offered is at the rate of £1500 per annum, ... to experience. Free furnished quarters and ... medical attention are provided. The first year ... probationary, and, if satisfactory, home leave ... granted at the end of three complete years' ... Married accommodation cannot be promised ... one year.—Applications, stating age and giving ... details of experience, should, in the first instance ... addressed to the Secretary, Ewbank and Part... Limited, 10/11, Grosvenor Place, London, S.W.1. E6727

GOVERNMENT OF THE PUNJ... INDIA

GOVERNMENT CENTRAL WORKSHO...

DESIGNER

Applications are invited for a post of DESIGN... at the Government Central Workshops, Amr... Punjab, to take charge of drawing branch.

Candidates, should have Civil or Mechan... Engineering Degree from a recognised Univer... or be A.M.I.Mech.E. or equivalent qualifica... at least two years' workshop apprenticeship ... subsequently ten years' experience in a respon... position in a drawing-office in design and drawing ... steel structures (irrigation gates, gearing bridges, ... trusses, &c.). Should be familiar with specifica... of material and able to prepare estimates and ... ments of materials from drawings ; good ... ciplinarian and capable of organising office wo... age not more than 45 years.

Contract for three years with prospect of extens... Pay according to age and qualifications up to Rs. 1... plus £30 overseas pay monthly for persons of N... Asiatic domicile (approximately £1507 per annu... Dearness allowance, provident fund, free pass... quarters provided on payment of rent.

Further details and application forms on appli... tion by postcard, quoting 8/9 D, from the High C... mission of India, Aldwych, London, W.C.2. ... date for receipt of applications 7th February, 195... E68...

SOUTH EASTERN GAS BOARD

ROTHERHITHE WORKS

ELECTRICAL SUPERINTENDENT

Candidates, who should preferably be Associ... Members of the Institution of Electrical Engine... but should in any case hold qualifications gi... exemption from the graduateship examination, ... be familiar with the installation, operation, ma... tenance and inspection of A.C. generating pla... main switchgear, motors, manually operated ... automatic control gear and armoured cables. ... knowledge of high-tension switchgear and mercu... arc rectifiers would be an advantage.

The successful applicant will be responsible to ... station engineer for electrical maintenance. T... works have been recently reconstructed, including ... installation of its own power system, the capacity ... which is 300kW.

Salary within the range £695–£795 p.a.

Applications, giving full particulars of train... qualifications and experience, and quoting refere... V14/291, should be sent to the undersigned not l... than fourteen days after the publication of this not...

R. J. McCRAE,
Personnel Manage...

Katharine Street,
Croydon. E67...

TENDERS

CITY OF COVENTRY

OMNIBUS GARAGE, SANDY LANE

STRUCTURAL STEELWORK

TENDERS are invited from suitably experien... firms for STRUCTURAL STEELWORK for a la... Omnibus Garage at Coventry.

Full particulars, bill of quantities, form of Ten... &c., from Council's Consulting Engineers, Husb... and Co., 70, Victoria Street, London, S.W.1. Dep... of £5 will be required payable City of Cove... Corporation, and sent direct to the Engineers.

The latest date for receipt of Tenders will be 3... January, 1953.

D. E. E. GIBSON,
City Architect and ...
Planning Officer.

Bull Yard,
Warwick Row,
Coventry,
January 9th, 1953. E68...

THE ENGINEER

JANUARY 9, 1953

The New Year Honours

THE New Year Honours List was published on Thursday morning, January 1st. It announces the conferment of honours upon a number of engineers and others closely associated with the engineering and allied industries. Among those elevated to the Peerage is Sir Clive Baillieu, K.B.E., chairman of the Dunlop Rubber Company, Ltd., and a past-president of the Federation of British Industries, who becomes a Baron. Knighthoods are conferred upon Mr. John Benstead, deputy chairman of the British Transport Commission; Mr. A. G. E. Briggs, assistant managing director of Tube Investments, Ltd.; Dr. H. Roxbee Cox, chief scientist, Ministry of Fuel and Power; Mr. Lincoln Evans, general secretary, Iron and Steel Trades Confederation; Mr. C. K. F. Hague, deputy chairman and managing director of Babcock and Wilcox, Ltd.; Mr. R. J. Hunt, director of R. Hunt and Co., Ltd.; and Mr. W. H. Pilkington, chairman of Pilkington Brothers, Ltd. In the Most Honourable Order of the Bath the following are created C.B.: Rear-Admiral (E) F. T. Mason; Major-General L. E. C. M. Perowne and Major-General J. C. Walkey, late Corps of Royal Engineers; Major-General Harold Williams, late R.E. and at present on loan to the Government of India as engineer-in-chief, Indian Army; Mr. John Buckingham, Director of Research Programmes and Planning, Royal Naval Scientific Service, Admiralty; Dr. W. H. Glanville, Director of the Road Research Laboratory, and Mr. R. Spence, chief chemist, Atomic Energy Research Establishment. In the Order of St. Michael and St. George, the C.M.G. is conferred upon Mr. R. W. Foxlee, engineer-in-chief, Office of the Crown Agents for the Colonies. In the Most Excellent Order of the British Empire, Lord Brabazon of Tara becomes G.B.E., and the following are created K.B.E.: Mr. G. H. Fretwell, Director-General of Works, Air Ministry; Sir Robert Gould, chief industrial commissioner, Ministry of Labour; and Colonel H. C. Smith, chairman of the Gas Council. The following are created C.B.E.: Rear-Admiral (E) F. S. Billings; Brigadier W. P. B. Ashton, R.E.M.E.; Mr. Ove Arup, architectural engineer; Group Captain R. J. F. Barton, lately managing director, Air Service Training, Ltd.; Mr. E. E. H. Bate, chief works engineer, Ministry of Works; Mr. H. T. Bennett, managing director, Marconi Telegraph Company of Egypt; Mr. F. J. Bywater, chairman of the Council for Codes of Practice; Mr. R. B. Carnegie, county surveyor of Devon; Mr. H. F. Carpenter, secretary, British Electricity Authority; Mr. W. Cawood, deputy director, Royal Aircraft Establishment; Mr. H. A. Cruse, director, Westinghouse Brake and Signal Company, Ltd.; Mr. B. A. W. Dickson, lately general manager, Vickers-Armstrongs, Ltd. (aircraft section); Mr. F. P. Egerton, general manager, Central Electricity Board of Malaya; Mr. W. M. Hargreaves, director of navigational services (aerodromes), Ministry of Civil Aviation; Mr. F. E. Hough, chief mechanical engineer, Rhodesia Railways; Captain G. S. Kennedy, marine superintendent, Orient Line; Mr. W. D'Arcy Madden, chairman and managing director, Hick, Hargreaves and Co., Ltd.; Mr. W. J. Mason, director of Ordnance Factories, Pakistan; Mr. P. H. Pettiford, superintendent, operative department, Royal Mint; Mr. H. J. Poole, chief superintendent, Armament Research Establishment; Mr. F. I. Ray, director, London Telecommunications Region, G.P.O.; Mr. J. A. Smale, engineer-in-chief, Cable and Wireless, Ltd.; Mr. C. A. P. Southwell, managing director, Kuwait Oil Company, Ltd.; Mr. H. Sparrow, chief mechanical engineer, N.W. Railway, Pakistan; Mr. A. H. Topham, joint managing director, Mawdsleys, Ltd.; Mr. A. Turnbull, vice-chairman, Royal Technical College, Glasgow; Mr. C. J. Turner, chief engineer, Division of Atomic Energy (Production); Mr. L. C. Tyte, deputy chief scientific officer, Fort Halstead (Ministry of Supply); Mr. H. R. Watling, lately director, British Cycle and Motor Cycle Manufacturers and Traders Union; Mr. S. A. H. Whetmore, Billingham Division, Imperial Chemical Industries, Ltd.; and Mr. James Williamson, senior partner, James Williamson and Partners.

Regulations for Preventing Collisions at Sea

THE Ministry of Transport announces that the International Regulations for Preventing Collisions at Sea, 1948, approved by the International Conference on Safety of Life at Sea, have been accepted by thirty-seven countries and, now that substantial unanimity has been reached, H.M. Government, as requested, has given a year's notice of the date when the 1948 Regulations will come into force, namely, January 1, 1954. Among the more important changes introduced by the 1948 Regulations are that the Regulations now apply to seaplanes on the water, and the second white masthead light becomes compulsory except for vessels less than 150ft in length and for those engaged in towing. The range of visibility of lights on fishing vessels is standardised at 2 miles, while the range of visibility of the stern light, which is now compulsory, is increased from 1 mile to 2 miles. For vessels under 150ft in length the range of visibility of anchor lights is raised from 1 mile to 2 miles and from one mile to 3 miles for ships over that length. Another item refers to a power-driven vessel which, under the Regulations, is to keep course and speed, is in sight of another vessel and is in doubt whether the other vessel is taking sufficient action to avert collision, she may use a signal consisting of five short blasts.

The British Association

ON Friday last, at a meeting in London, Sir Edward Appleton, F.R.S., Vice-Chancellor of Edinburgh University, was installed as the 114th president of the British Association for the Advancement of Science. Both Sir Edward and his immediate predecessor in the presidential chair, Professor A. V. Hill, are Nobel prize-winners. Sir Edward received the Nobel prize for physics in 1947, while Professor Hill gained the prize for physiology and medicine in 1922. Speaking at the ceremony last Friday, Sir Edward said that he looked upon the British Association as a "peripatetic university," which asked only one thing of its members—a love of science. At this year's meeting of the Association in Liverpool next September, Sir Edward continued, it was hoped that there would be present about 1000 sixth-form students from schools in and around the city, and it was his intention to give a special presidential address to that junior audience. He was anxious that the meeting should emphasise that there was, as Francis Bacon had said, "science for knowledge as well as for the relief of man's estate."

B.W.R.A. Summer School of Welding

AN announcement has been made this week that the third Summer School of Welding, organised by the British Welding Research Association, will be held at Ashorne Hill, Leamington Spa, Warwickshire, from Monday, April 27, to Saturday, May 2nd. This year the general theme of the course is welding fabrication and production. The school will commence with lectures giving critical and comparative studies of welding processes, plant and basic materials. Then students will be given instruction in welding design, followed by lectures on works planning and welding costs and the more efficient use of up-to-date processes, such as automatic welding. Finally, the use of standardisation, time and motion study and other means of improving production will be dealt with, and the course will also include lectures on non-destructive testing and inspection of welds and other items of special interest. To assist organisations with staffs particularly interested in one aspect of welding, the school is to be divided into groups. Following morning lectures of general interest the afternoon lectures will be on more specialised subjects under five group headings, namely: aircraft industry, shipbuilding industry, structural engineering, automobile and sheet metal industries, and general engineering. The school will be of use to those interested in improving welding methods and production efficiency, and those wishing to attend can obtain application forms and particulars from the Secretary, B.W.R.A. Summer School of Welding, British Welding Research Association, 29, Park Crescent, London, W.1.

The James Watt International Medal

THE Council of the Institution of Mechanical Engineers has awarded the 1953 James Watt International Medal to Sir Harry Ricardo, F.R.S., for his contributions to the knowledge of the fundamental principles of internal combustion engines and the application of those principles to design and development. Sir Harry, who is the chairman and technical director of Ricardo and Co., Ltd., is a past-president and honorary member of the Institution of Mechanical Engineers. The Watt International Gold Medal was established by the Institution in 1936 to commemorate Watt's birth in January, 1736. A medal is awarded every two years to an engineer of any nationality who is deemed worthy of the highest award the Institution can bestow and that a mechanical engineer can receive. In making the award, the Institution has secured the co-operation of the principal engineering institutions and societies in all parts of the world as nominating authorities. The first award of the medal, in 1937, was made to the late Sir John Aspinall for his work on the development of the railway locomotive, and the last three awards, in 1947, 1949 and 1951 respectively, were to Professor Stephan Timoshenko (U.S.A.), Dr. Fredrik Ljungstrom (Sweden), and Dr. H. H. Blache (Denmark). This year's medal is to be presented to Sir Harry Ricardo at a general meeting of the Institution, to be held at Storey's Gate, Westminster, S.W.1, on Friday, January 23rd, at 5.30 p.m.

The Australian Road Federation

THE Australian Road Federation has recently been incorporated. The Federation is intended to serve the interests of the industrial, commercial and mining communities and the tourist and road transport industries as they are affected by roads and road transport, and it is from these groups that it derives its membership. Its general policy is to further the development and safety of the road system in Australia, both from the technical and political points of view. Its immediate policy, it is stated, is to "encourage and, if necessary, undertake study and research into road improvements to meet national requirements; obtaining the lowest cost roads; the training of personnel; traffic control, and the co-ordination of road traffic with rail, air and sea transport."

Civil Engineering in 1952

No. II—(*Continued from page* 17, *January* 2*nd*)

TOWARDS the end of 1951, the London County Council's development plan, as required by the Town and Country Planning Act, was published, and during the latter part of the year under review objections to the plan were being heard. The development plans of other cities were published during the year. Generally, such development plans have not proposed any radical changes of particular interest to the civil engineer, such as might be expected to deal adequately with present-day traffic, for instance, but have concerned themselves with more modest suggestions of improving some particularly congested thoroughfares or bad areas, whilst leaving the general layout of a city substantially unaffected.

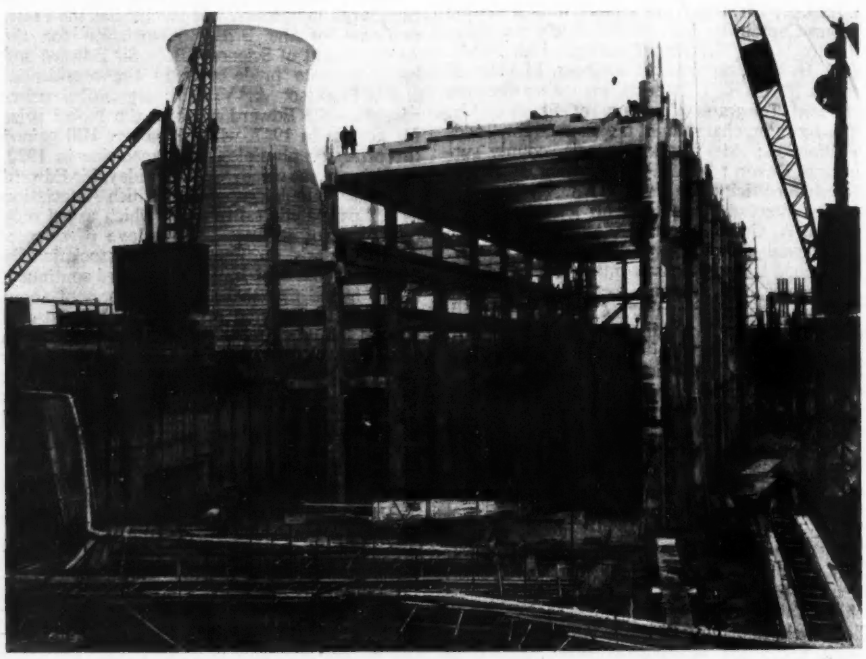
Proposed Development at Paddington Goods Yard

By contrast, the illustration above shows a scheme proposed for a new "town" at Paddington, known as "High Paddington." Whilst this proposal is primarily of architectural interest, its significance from the purely structural standpoint as well as from that of town planning, will, perhaps, justify its inclusion here, although the scheme has not been officially adopted. The basic idea is to build the large structure, shown in our illustration superimposed over a photograph of Paddington, over the station goods yard, allowing the yard to continue its operation underneath the base or podium of the structure. The base would contain a number of floors of commercial and industrial property and would extend to a height of about 100ft. The top of it would form a town centre with about 16 acres of open space, the dwellings above rising to a height of 340ft. The scheme would thus provide all the amenities of a small town of 8000 or so inhabitants. This original conception is the work of Mr. S. Kadleigh.

Returning now to the practical achievements of 1952, our second illustration shows the structural frame of the turbine house of the Acton Lane "B" power station in North-West London, as it was early in 1952. This structure is an innovation in power station construction, as its constituent members are of precast concrete. The columns and beams were cast on the basement floor and were then erected with the two derricks. Formwork for various precast members may be observed in the foreground of the illustration with a column stripped from its forms on the right. The frame was erected from the direction of the background of the illustration, the forms for the newly cast elements being carefully positioned to allow a steady progression of casting, striking and erecting, the derricks moving forward as the work went on. The precast units are believed to be the largest ever used—the principal columns are 66ft long and weigh about 30 tons each—and the resulting structure is analogous in many respects to a conventional steel-framed structure. Detail drawings of these large precast units, and a description of the various problems, such as providing some rigidity at the joints, which this new method involved, were given in our issue of February 1, 1952. The contractor to the B.E.A. for the civil engineering and precast work was Sir Robert McAlpine and Sons, Ltd., and the consulting engineers for the precast concrete design were Messrs. Brian Colquhoun and Partners.

As far as design in structural steel was concerned, 1952 saw further progress in the development of the plastic theory as applied to the design of steel structures. A paper on this subject (one of those presented at the fourth International Congress of Bridge and Structural Engineering) was published in our issues of September 5th and 12th last. A new two-storey transit shed at Southampton Docks, for the Docks and Inland Waterways Executive, which was in the design stage in 1952, may be given as an example of the progress of this work. The shed is planned to be of welded steel-frame construction; the steelwork for the first floor, which is to form a heavy storage area, is being designed by the "collapse load" method and the roof structure is of light umbrella type construction, giving an unobstructed floor area below 108ft wide by about 930ft, the full length of the shed. The consulting civil engineers for the superstructure are Messrs. Scott and Wilson, in association with Mr. J. H. Jellett, the Docks Engineer.

As an example of a steel structure on which work was in progress during the year, we give some notes on the extensions to the Pontypool factory of British Nylon Spinners, Ltd. Rapid progress was made with this work during 1952. The original factory, when completed in 1948, was reputed to contain the largest building under one roof in Europe and the extensions will increase its ground area by nearly one-third. In addition, a separate new stores building to provide 45,000 square feet of covered storage area was being built and work started recently on two-storey research and office blocks. Contracts for the preparatory works and for the main foundations were placed in the spring of 1951 and all were completed before the end of that year. Work on the main building contract was started at the beginning of 1952 and the first and major phase was approaching completion at the end of the year. The preparatory works included extensions to the factory sewage works to double its capacity and the removal from the site of a reinforced concrete car shelter, 230ft long, weighing 400 tons. This shelter, complete with its founda-



Precast Concrete Turbine House Structure, Acton Lane Power Station

tions, was jacked up in six pieces, transported to, and reinstalled successfully on, another site about 100 yards away.

The extensions to the main factory comprise five main blocks adjoining the 980ft long north side of the existing building. Along this side the ground strata dip from the west end, where there is good marl at ground floor level, to the east end, where the marl is about 25ft down and is overlaid with material of small load-bearing capacity. These conditions led to the adoption of concrete block foundations for the two westerly blocks and piled foundations for the other three. Owing to the presence of underground water and the necessity of avoiding vibration of the nearby factory machinery, piles of special design, comprising precast octagonal shafts housed in 18in diameter borings, were used. Reinforced concrete ties prestressed by the Magnel-Blaton system were incorporated in the ground floors to take the horizontal thrusts from the steel portal frames founded on the piles. The superstructures, like the original factory, are steel framed with reinforced concrete floors and flat roofs, brick cavity walls and large windows ; but the new main steelwork designs are radically different from the originals because they had to meet more onerous conditions whilst retaining the same construction depths and headrooms.

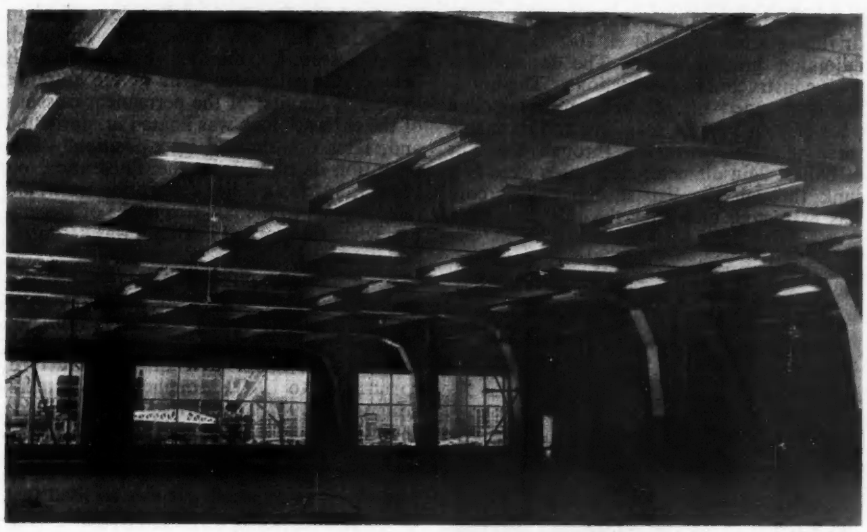
Our first illustration of this work is an interior view of the first block at the west end. This and the next two blocks comprise a 72ft span bay with either one or two 54ft span single or double-storey bays and the maximum permissible frame construction depths, except at haunches, were 32in in the first floors and 30in in the roofs. To meet these and the other essential conditions the main steelwork in these sections consists of several unusual types and arrangements of portal frames and continuous girders, with standard outlines and cross sections wherever practicable. Plain rolled steel sections were used for the secondary members in all the blocks.

The second illustration shows the 180ft long extension to the extrusion bay in course of construction. This extension is 90ft clear span and 42ft high. The main frames are all welded plate girders and stanchions, the shell of the bay being designed to stand on its own at any time, without internal floors and framing.

The new stores building is founded on red marl and is of fully rigid design. The main frames, of 22in by 7in joists, are 100ft wide and 22ft high above ground, with centre props and intermediate beams on one side to carry a heavily loaded reinforced concrete first floor over half the building. The roof is of asbestos cavity decking on continuous steel purlins.

The structural steelwork in the extensions comprises about 2700 tons in all and is welded throughout except only site joints that had to be made in the air. These joints were riveted or, for secondary members, bolted and were kept to a minimum. To facilitate rapid, economical fabrication and maintenance, stiffeners and other fittings were avoided wherever practicable. The leg and knee of a main portal frame is illustrated overleaf, and, with the other illustrations, indicates the clean lines of the steelwork.

The consulting architects for this work are Sir Percy Thomas and Son, and the consulting engineers are Messrs. Scott and Wilson. Willment Bros., Ltd., were the contractors for the sewage works extensions and other ancillary works, whilst the Cementation Company, Ltd., carried out the main foundations contract and the moving of the car shelter. Sir Robert McAlpine and Son (South Wales), Ltd., are the general building contractors and Braithwaite and Co. (Structural), Ltd., the steelwork sub-contractors.

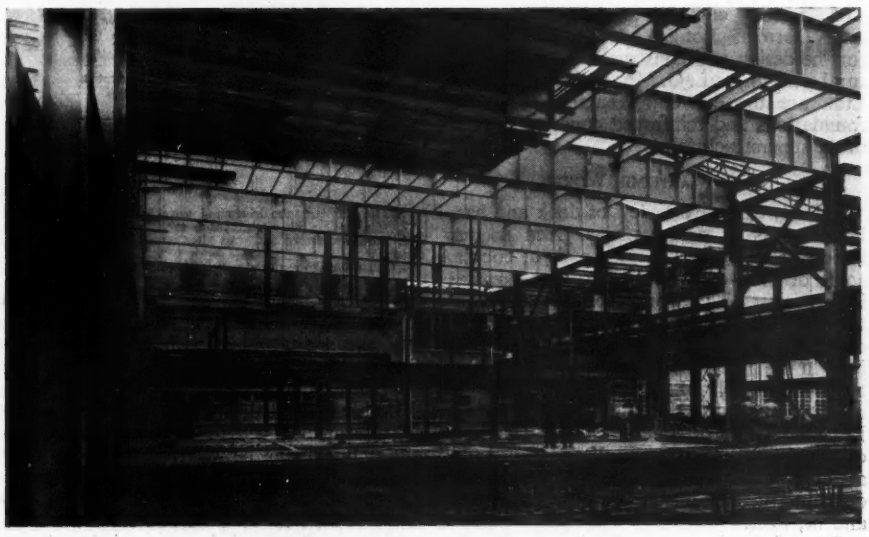


Steelwork of Nylon Factory Extension at Pontypool

A Foundation Problem

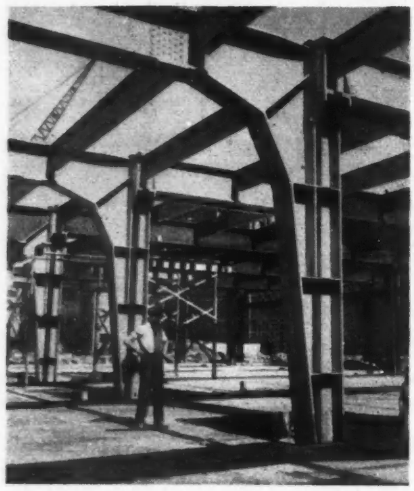
Another interesting work in progress during the year concerned the substructure of the new recovery house at Plaistow Wharf for Tate and Lyle, Ltd. This building has many interesting features, exemplifying how modern advancements in civil and structural engineering are enabling special sugar refining plant to be installed to the best advantage. To house this plant the building had to be at least 205ft high, 63ft wide and 124ft long and for efficient working of the plant it is being built on a site surrounded by existing buildings. The existing building on the east side actually extended partly over the site for the new building which necessitated a portion of the new building being supported on large cantilevers below ground level. Further, the total load due to the plant, superimposed load, and self-weight of the building, was such that the average load transmitted to the ground was 5¼ tons per square foot. Exceptional care had, therefore, to be taken in the design and construction of the foundations.

A very thorough site and ground investigation was carried out so that adequate foundations for the building could be provided with the least possible interference with the surrounding buildings. The investigations included the sinking of two deep borings, the testing of samples extracted from the borings, the sinking of a trial hole and the driving and subsequent testing of a test pile. These investigations revealed that the top 20ft of ground contained old mass concrete foundations resting on a ballast stratum, that this ballast bed was 20ft thick, and below it was a 12ft bed of London clay, a 22ft bed of granular material, and then the Woolwich and Reading clay bed was reached, as shown in the illustration. The level of the water in the ground was influenced by the tides in the Thames. Further, the laboratory tests and soil mechanics calculations revealed that it would be necessary to employ piles to penetrate into the granular stratum below the London clay. The depth to which the piles were driven is also indicated in the illustration. To construct the foundations ground water lowering was used to enable a trench to be cut through the existing foundations around the periphery of the site, which was excavated in short lengths ; steel sheet cofferdam piles were driven as this work proceeded. The mass concrete foundations which covered a considerable area of the site and which rested on the



Construction of Nylon Factory Extension at Pontypool

ballast bed, were then removed and the pile driving started at a level 20ft below the adjoining ground level. The foundations were constructed in two sections. The building is founded on 556 reinforced concrete piles of 16in by 16in scantling and to enable these piles to be driven through the 20ft of ballast 24in diameter steel tubes were first sunk through the ballast, the ballast core was extracted, and after the pile had been



Steelwork Detail at Pontypool Nylon Factory Extension

pitched and the void between the pile and the tube filled with sand and gravel, the steel tube was extracted and the pile was then driven until it reached its set in the granular bed underlying the London clay. A photograph reproduced on this page shows some of the steel tubes. The tubes were filled with water whilst the ballast was being removed.

The load from the steel stanchions is spread to the piles by a deep raft of cellular construction. The building is steel framed with structural steel cantilevers below ground floor level, and with stiff connections between stanchions and girders which make it possible to omit wind bracing. Provisions have been made to permit extensions to be carried out at a later date. The work is being carried out under the jurisdiction of Mr. Carmichael, deputy chief engineer of Tate and Lyle, Ltd. Soil Mechanics, Ltd., carried out the soil mechanics investigations and the ground water lowering ; John Mowlem and Co., Ltd., is the civil engineering contractor, and Dorman Long, Ltd., is responsible for the design and construction of the structural steelwork. L. G. Mouchel and Partners, Ltd.. are the consulting engineers for the foundations and reinforced concrete portion of the superstructure.

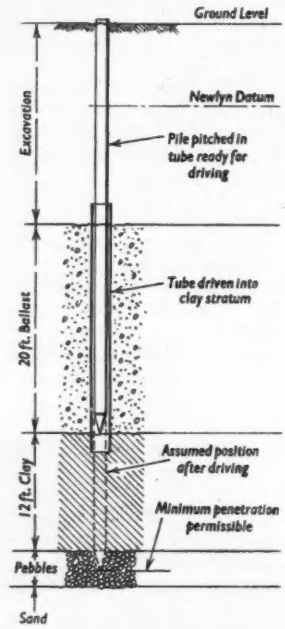
Some Maritime Works

A fairly extensive review of dock and harbour works in progress was given in our review at this time last year and, of course, some of the works referred to then are still in progress. The works completed during the year also included several which were described then, including the large oil jetty in the Thames Estuary, built in connection with Shell Haven refinery, and the reconstructed dry dock of C. H. Bailey, Ltd., at Barry, in South Wales. The new dry dock of T. W. Greenwell and Co., Ltd., at Sunderland was also completed ; it was described in The Engineer of October 10 and 17, 1952.

One of the largest works in progress in 1952 was the oil dock at Eastham. Early in the year the large full tide cofferdam protecting the new dock was breached, after a second cofferdam had been built between the completed walls of the entrance lock, and the first of the permanent caissons of the entrance lock was floated in, uprighted and, later on, stepped into position. This operation is shown in the illustration on Plate 9, but for a fuller description we would refer readers to the last two issues of December, when the work at Eastham was described and illustrated.

An interesting repair job was carried out on a jetty during the year to the designs of L. G. Mouchel and Partners, Ltd., the contractors being John Mowlem and Co., Ltd. The original part of this structure, constructed to L. G. Mouchel and Partners' design in 1904, comprised an approach 180ft long and a tee-head 96ft long, each being 19ft wide. An extension was later added to the tee-head but it is the old structure that was repaired. It was realised that the original portion of the jetty, now forty-eight years old, had been used to carry very much increased loads from those for which it had been designed and it was therefore decided to make a thorough investigation as to its condition and the loads which it was capable of carrying.

The structure consisted of a beamed decking bearing on 2ft 6in cylindrical piers, each pier bearing in turn on a single reinforced concrete pile. The disposition of the piers divides the decking of the approach into bays of approximately 25ft by 16ft and the tee-head into bays of approximately 20ft by 16ft 6in. The design of the piers comprised a reinforced precast cylindrical shell 3in in thickness lowered over the head

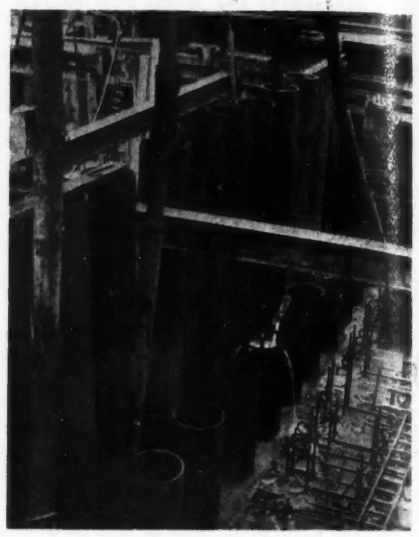


1. 24in diameter tube driven and gravel inside extracted.
2. 16in by 16in pile pitched inside tube.
3. Tube withdrawn and void filled with sand as tube is withdrawn.
4. Pile driven to required penetration and set.

Details of Pile Driving and Strata at Plaistow Wharf

of the pile, the space between the shell and the pile being filled with mass concrete. Examination by divers revealed that the river bed, which is of chalk, had been considerably eroded during the course of years, an unprotected length of some 2ft 6in of pile only existing between the river bed and the underside of the front concrete piers of the tee-head. It was obvious that the latter needed to be underpinned down to a level some distance below the existing shore. The piles, however, proved to be quite sound, in spite of the fact that, unaided, they had for an unknown number of years been taking the full brunt of the shock due to barges and other craft berthing alongside the jetty.

The river bed at the foot of the columns was therefore excavated down to good bearing chalk and the bottom edge of the piers trimmed off to an angle of about 30 deg. sloping down to the pile. A sheet steel



Tubes Used for Pile Driving at Plaistow Wharf Recovery House

flanged and bolted shutter 3ft 6in square (made in convenient lengths and sections) was then assembled around the bottom of each faulty pier, divers placing the shuttering in position and arranging sand bags on the outer side to seal the junction between the shutter and the chalk.

Concrete was then filled into the shutter with two 8in diameter tremie pipes, the divers seeing that contact between the tremie pipes and the deposited concrete was never broken. As the work proceeded additional sections were added to the shutter and the concrete was brought up to a height of some 10ft above the chalk. The mix used was very rich to compensate for the cement lost by the flow of the river and was kept as dry as possible consistent with it passing down the pipes. Nominal reinforcement was introduced in the salient angles of the new square concrete piers, the tops of which were finished off with a splay to the circular columns. Subsequent examination by divers confirmed that the above operations had been entirely successful.

Considering its age and the fact that it had been very greatly overloaded for many years, the decking was in surprisingly good condition. The beams, which had been designed to carry crane rails on one side of the approach and a narrow gauge railway on the other, were found to be of adequate strength to carry the loads now required. On the other hand, the decking slab, originally designed for a general superload of 3 cwt per square foot was now to carry 10-ton cable drums hauled by a tractor along the approach and it was, of course, too weak for this duty. Originally a 7in thickness of screed and asphalt had been laid on the decking. This was removed and a new reinforced concrete slab substituted, which, combined with the strength of the original slab, was designed for the load now required. Wrought iron was used for reinforcement, mild steel not being available.

(To be continued)

The Royal Navy, 1952

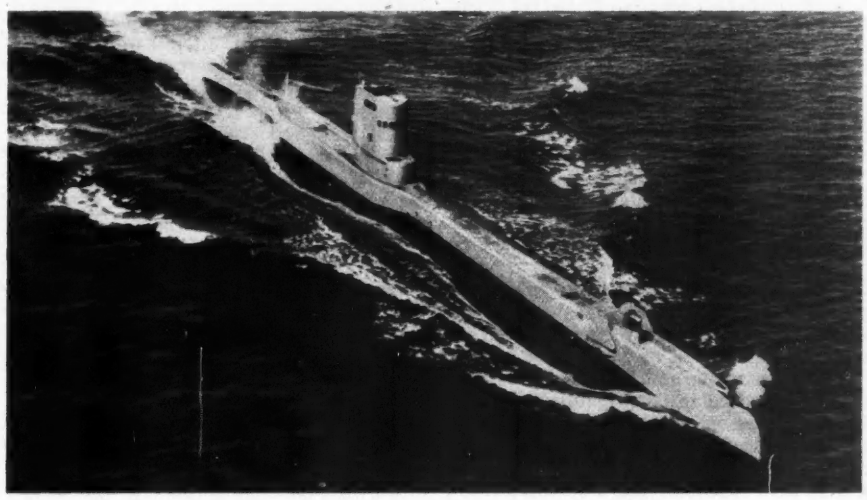
(By our Naval Correspondent)

No. II—*(Continued from page 7, January 2nd)*

Cruisers.—In pre-war days cruisers were required to accompany the battle fleet for reconnaissance duties and to guard the many focal areas of trade. The minimum number needed was authoritatively estimated to be seventy and we had sixty available in 1939. To-day there are only twenty-four—a figure which would give serious cause for anxiety were it not for the large number of cruisers in the United States Navy. The number of focal areas of trade has not in any way diminished and if Russia is in an unfavourable geographical position and has only about twenty cruisers suitable for attacking trade, she has a sizable merchant marine with several fast ships which could be powerfully armed and sent out on the trade routes disguised as peaceful merchant vessels. And although there are no battleships to scout for, many cruisers will be needed for task forces to protect the carriers against attack by other types of ships, particularly in foggy weather and at night, when their aircraft cannot operate effectively. One has indeed only to read of the splendid work of the "Ceylon," "Belfast" and "Kenya" in Korean waters to realise the many and varied duties cruisers are called upon to perform. Apart also from war requirements, a powerful squadron of cruisers sent on a peaceful visit to a foreign port in times of excitement is much more likely to produce a peaceful solution to the matter in dispute than the dispatch of an anti-submarine frigate! Good progress has been made in the modernising and re-equiping of our existing cruisers—the "Birmingham," "Newcastle" and "Newfoundland" have already been modernised—but it seems high time that work was resumed on the three "Defence" class cruisers laid down during the war. The construction of these ships was suspended some years ago pending a decision on the kind of armament they are to have—a problem now under investigation in the old cruiser "Cumberland," which has been fitted as an experimental ship.

Destroyers.—Four of the eight "Daring" class, laid down during the war, have now been completed and all the remainder should have joined the fleet by the summer of this year. These ships are of 2600 tons and, with their six 4·5in guns in twin turrets disposed as in cruisers, might well be classified as "light cruisers," if such a category were ever again introduced. In that connection it is as well to remember that unnecessary expense might be involved if they were officially classified as cruisers, since they would then be entitled to bands and other perquisites applicable to the "large ship." The Royal Navy had also until recently 110 other destroyers, but the Admiralty is wisely converting forty-five of them into fast anti-submarine frigates, (Plate 3, Jan. 2nd) of which six have joined the fleet and thirteen more are in hand. Some are to have a simpler form of conversion without the refinements of the remainder, though they will be still very effective as modern anti-submarine vessels. Conversion will give these forty-five ships a much larger radius of action, make them better sea-boats and provide them with a powerful anti-submarine equipment in lieu of their existing gun and torpedo armaments. Conversion is indeed the quickest method of providing the force of modern, fast anti-submarine vessels urgently required to replace the 160 war-time 19 knot frigates which are not fast enough to chase, still less to destroy, the modern submarine with fast submerged speed. Thus, we are left with sixty-five destroyers—in addition to the eight "Daring" class—as against the eighty-odd Russian destroyers, which include six ex-German and six ex-Italian vessels, most of which are fitted for minelaying. Presumably, the Admiralty is satisfied that this number will meet task force requirements, for according to a recent statement by a member of the Board of Admiralty, the "Daring" class are likely to be the last vessels, recognisable as the conventional destroyer, to be built for the Royal Navy.

Frigates, Minesweepers, Patrol Craft and Submarines.—Twenty-four new, fast anti-submarine frigates are to be completed under the rearmament programme by 1955 and, as in the case of destroyers, there are to be two kinds, one costing about £1⅛ million, compared with £500,000 for a converted destroyer, and the other of simpler design without so many refinements. Two other types of frigates are also being constructed, one for anti-aircraft defence and one specially fitted for aircraft detection. The programme includes sixty-five coastal and inshore minesweeping vessels of a new kind. The former, of which seventeen have been launched, have a length of 152ft and aluminium is used both for the framing and structural castings. The out skins are wood planked, the whole of the hull thus being of non-magnetic material. Twenty inshore sweepers have been launched. These vessels have a length of 106ft, and are intended for operating in shallow waters, such as rivers and estuaries. Both types have been specially designed to deal with magnetic and acoustic mines. Russia has always been expert in the manufacture of the latest type of mines and she has at her disposal German technical experts and the blue-prints of the mines in use by Germany up to 1945. It would, indeed, require a very substantial effort by the Western European nations to maintain swept channels in the approaches to their harbours. The remainder of the 200-odd vessels to be completed under the programme are patrol craft of various sorts. Some of them are to be fitted with a new light-weight, high-powered diesel engine, known as the "Deltic," which gives increased performance and improved reliability over the petrol engine hitherto used in this class of ship. Others are motor torpedo boats of entirely new design, with wooden hulls, incorporating structural members of water-resistant plywood, and driven by conventional Packard petrol engines. Based on experience gained from running the "Gatric" engine in M.G.B. "5559" in 1947, two motor torpedo boats—the "Bold Pioneer" and the "Bold Pathfinder"—recently completed, have been powered by gas-turbines in combination with diesel engines. Another type of patrol vessel is a seaward defence ship, with a length of 117ft and powered with diesel engines. Her function is to detect and destroy submarines—including midget submarines—in the approaches to defended ports. The first of these craft was launched at Yarrow and Co.'s yard in August. No new submarines are being laid down and the loan, recently, to the French Navy of four—one of which has since been lost with all hands—of our existing vessels leaves the Royal Navy with only fifty-one submarines. The majority have been or are being fitted with a snort, and are having all unessential upper deck fittings removed for faster underwater speed as the illustration herewith indicates. Where practicable, increased battery power is also being installed to give them a submerged speed approximating to that of the modern submarine (17 knots).



H.M. Submarine "Tireless"

The Submarine and Anti-Submarine Situation To-day.—By the middle of 1943, when U-boat construction could barely keep pace with losses, the Germans realised that the kind of submarine which had formed part of the navies of the Great Powers for the previous forty years was no match for an opponent adequately provided with anti-submarine vessels and aircraft. They accordingly concentrated on developing a true submarine—a vessel which would normally navigate submerged at an effective speed instead of a surface vessel that relied for her offensive and defensive power on her ability to submerge when required. Shortage of manpower and material and allied air raids, however, thwarted their plans and they succeeded only in pointing the way to the types of true submarine built or building at the present day. The first of these is the streamlined, large battery snort-fitted vessel, which can maintain a submerged speed of

17 knots or more for about an hour. Strictly speaking, this vessel is not a true submarine, for although she can, and no doubt will, remain submerged from the time of leaving harbour until the completion of her patrol, she must keep her snort above the surface—at periscope depth—when using her engines; and in fine weather, when there are no waves to cause blobs of light on the radar screen, radar can nowadays detect a snort at a distance of several miles, thus restoring to aircraft some of the great value they had in World War II for convoy escort work. Moreover, while a submerged speed of 17 or 18 knots enables a submarine to evade our war-time frigates, it will not give her immunity from a destroyer or the new fast frigates we now have under construction.

Thus, if we are given the necessary time to build adequate numbers of fast modern anti-submarine vessels and aircraft with the necessary suitable carriers—and it is a very large "if"—the Western nations should be able to deal with submarines of this type. How many Russia has available is anybody's guess. She is now believed to have over 300 submarines, many of them modern, built or converted under German supervision. But at the end of the war Germany had under construction a much more formidable true submarine, which dispensed with the snort and was to be driven by two Walther cycle engines using hydrogen peroxide of 90 per cent purity as oxydant for fuel and giving, it was claimed, a speed of 25 or 26 knots. The United States Navy is now building a submarine of this type and another, driven by nuclear power, which also requires no air and will, it is reported, have a still higher speed. She is to be ready by 1954 and as no question of refuelling arises, she will, of course, have almost unlimited range.

United States naval authorities have the utmost confidence in this nuclear power driven submarine and, according to unofficial reports, regard it as more satisfactory than the Walther cycle engine submarine in view of the explosive nature of hydrogen peroxide and the possibility of available supplies being required for guided missiles. In both types, air for the crew can be carried in condensed form and the exhaled carbon dioxide removed by conventional means. Radar will not be effective against them and their high speed will give them the legs of all but the fastest surface vessels. Indeed, the problem of locating and destroying submarines proceeding at 25 knots at depths of 100ft, 200ft or 300ft is not going to be easy to solve, unless they are actually attacking and come within range of our detecting devices.

This is not to say that anti-submarine measures have been standing still. On the contrary, there have been remarkable developments since the war in methods of detection, notably in radar, asdic, sono and magnetic airborne detection devices, and there has been even greater progress in the missiles employed for destroying a submarine—depth charges, depth bombs, projector charges, homing torpedoes, and rockets. The rocket and the homing torpedo represent probably the most radical advances in undersea warfare since the war. The rocket launcher, which has already been installed in a number of ships in the United States Navy, fires a relatively large rocket with a heavy explosive charge at a range considerably in excess of 1000 yards. Its equipment incorporates an effective fire control system, which eliminates the difficulty that the firing ship had during the war of losing asdic contact at close range. This meant that other vessels were required to maintain contact while she carried out the killing. The homing torpedo is likewise a very valuable addition to the armoury of anti-submarine missiles. The cost is many times more than that of the conventional torpedo, due to the complicated electronics and sono gear built in, to guide it to the submarine. According to Rear-Admiral Schoeffel, Head of the U.S. Navy Ordnance Department, this "electronic brain" is even capable of distinguishing and sorting out "noise decoys" ejected from the submarine which the Allies employed to such good purpose against the last war version of the homing torpedo fired by U-boats. There is, indeed, little doubt that, once a submarine's position has been revealed—either by detection or by her attack—its subsequent career is likely to be harried and brief.

Detection of a completely submerged submarine, however, is still the main problem to be solved, for the effective range of detection is less than a submarine's effective attacking range. Utilising her own asdic installation to fire torpedoes from below periscope depth and firing homing torpedoes propelled by electricity which leave no wake and which may be set to circle until they find their quarry, the submarine still represents a most dangerous threat to shipping. And until underwater detection devices are developed which exceed the range of the submarine's missiles, she is likely to remain so.

Naval Aviation

With the "Eagle" now operating the Vickers-Supermarine "Attacker," the Royal Navy has at last begun the systematic replacement of piston engine aircraft with jets. The "Attacker" will in due course be replaced by the Hawker "Sea Hawk" as the Navy's single-seater day jet fighter, with the turbo-jet two-seater "Sea Venom"—a variant of the renowned de Havilland "Vampire"—now in quantity production, to fill the role of the Navy's standard night fighter. A still faster and more powerful naval fighter will soon be available in the Vickers Supermarine "508," a prototype having made successful deck landing trials on the "Eagle" last May. The Westland "Wyvern"—a single-seater torpedo-carrying turbo-prop—has been in production for some months as the Navy's future strike aircraft to replace the Blackburn "Firebrand," but it has not yet been put into squadron service. Finally, the new turbo-prop Fairey "Gannet" is earmarked as the Navy's new three-seater anti-submarine aircraft, with space for bombs, sonobuoys, depth charges and other anti-submarine missiles and detecting devices. It is interesting to note that the "Gannet's" Armstrong-Siddeley "Double Mamba" engine has recently been run on the diesel fuel used in ships for auxiliary engines. The use of diesel fuel, instead of paraffin, for naval aircraft gas turbines would, of course, avoid the complications arising from carrying special aircraft fuel in carriers, with separate storage compartments, pumps and pipes. The Navy is also being supplied with a substantial number of United States "Skyraiders"—a standard U.S. aircraft, modified for long-range anti-submarine patrols—and the R.A.F. Coastal Command with United States P2V-5 "Neptune" anti-submarine aircraft to supplement the Coastal Command Avro "Shackletons." The P2V-5 "Neptune" is powered by two engines—a combination of piston and turbine units. It has an exceptionally long range and can carry torpedoes, bombs and rocket projectiles and is fitted with the latest electronic devices for detecting submarines.

Expert opinion is by no means unanimous that long-distance aircraft patrols over the sea should remain a responsibility of the R.A.F. Coastal Command, but the Government is not prepared to consider any change at the present time in a system which has stood the test of war. The Navy flies relatively light ship-borne aircraft and the retraining of their crews to fly heavy long-range aircraft would be much more difficult than to retrain the crews accustomed to fly the heavy aircraft of bomber and transport commands. The Royal Navy is still short of pilots and observers, but the position is improving under the existing four methods of entry: (1) permanent general service officers; (2) former naval pilots and observers who rejoin for periods of from four to eight years; (3) direct entry of civilians for eight years' service with a gratuity, and (4) National Service men who volunteer for an additional two or six years' service. About eighteen months is required to train a pilot capable of deck-landing and the Admiralty have been glad to take advantage of a generous offer from the United States Navy to carry out the training of a proportion of R.N. pilots. Another R.N. air station has been commissioned at Brawdy, Pembrokeshire, as the Armament Training Station for front line jet fighter and night fighter squadrons and four more squadrons are being formed for the air branch of the R.N.V.R., making ten R.N.V.R. squadrons in all.

Dockyards and Maintenance

The modernisation and conversion of ships in addition to the normal work of refitting and repairing active and reserve fleet ships have kept the Royal Dockyards working to capacity throughout the past year. Progress has been hampered by a shortage of craftsmen and there is still a serious shortage of shipwrights. Between 500 and 600 vessels have been refitted in the dockyards during the past four years, apart from the refits of ships of Commonwealth and foreign countries, and while there has been some criticism of the existing organisation and administration, the high standard of the work carried out is beyond dispute. A considerable economy both in money and naval personnel has been achieved by the removal last year of a number of H.M. ships of the Reserve Fleet from the upper reaches of naval harbours to commercial ports—in the first instance to Cardiff, Penarth and West Hartlepool. Before removal they are "dehumified," which makes it possible to maintain them largely by civilian labour, with the consequent release of naval personnel for service elsewhere.

In new construction and carriers now being modernised, dining spaces, separate from the mess-decks, with adjoining serveries and sculleries are being provided to enable ships to have centralised general messing, one dining-hall for chief and petty officers and another for junior ratings. As the result of a trial in H.M.S. "Glasgow," it has not been found practicable to provide the additional dining spaces in cruisers. Trials are also being carried out in two destroyers to improve the messing arrangements by the installation of a servery and scullery adjacent to the galley for centralised serving of food and washing-up. Modern steam-heated and electric cooking equipment is being provided in all ships where sufficient steam and electric power is available and ships refitting are being installed with cool storage for vegetables and fruit. Carriers now completing are being fitted with portable, folding bunks, the bunk spaces being provided with nesting tables and chairs for recreational purposes. It is proposed to continue the policy in other new construction and modernised carriers.

Consideration is also being given to the provision of a small number of bunks in other types of ships for senior chief petty officers. In one ship a chief petty officers' bunk space is being fitted for trial, containing in addition to bunks, an appropriate number of kit lockers. Officers are as far as possible being provided with single cabins, as was the practice before World War II.

Consideration is now being given to a number of innovations in the clothing of officers and ratings. Preliminary trials are being made of new white plastic-topped caps, which it is intended should be worn by officers and men serving on home stations all the year round. Improved foul weather clothing has been devised to meet requirements in both temperate and cold climates and warm, detachable linings for raincoats are under investigation. Oilskin garments will eventually give way to those made from fabric impregnated with polyvinyl chloride, which will include trousers with either long coats, fitted with a hood in lieu of the Sou'-wester, or short smocks. In cold climates kapok-lined cotton garments will be worn under this water-proofed clothing and the duffel coat may disappear from the Navy's wardrobe.

The maintenance of the many new weapons and items of equipment already in service in the fleet raises many new problems. Much help is provided by the Medical Research Council and psychologists who are available to give advice, and the recent appointment of a scientist as a seagoing scientific adviser to the Fleet to obtain a closer integration of science and naval practice is producing valuable results.

(*To be continued*)

Labour in 1952

By GERTRUDE WILLIAMS

No. II—(*Concluded from page* 10, *January* 2*nd*)

Dock Labour Scheme

THE Dock Labour Scheme, which was inaugurated in its present form in 1947, is administered by the National Dock Labour Board with local boards in each port or group of ports. The boards are all similarly constituted—equal numbers of representatives of employers and unions—with the exception that the national board has an independent chairman. Employment in the docks is limited to registered workers, but once on the register, the worker receives a guaranteed weekly wage whether he actually works or not. Rates of pay depend, as usual, on voluntary agreements reached by collective bargaining between employers' associations and the unions, and weekly earnings are generally far above the weekly minimum. In fact, the average weekly earnings last year were in the neighbourhood of £10, whilst the "fall back" wage was £4 8s. But if, for any reason, the amount of work is slack, a registered worker gets £4 8s. at the end of the week whether the number of hours work he has done would have earned him this amount or not. The only condition is that he must present himself for work at the right times and be prepared to go to any part of the port where he is needed.

The size of the register—its "sanctioned strength"—is a matter for agreement between the members of the board, and, as the minimum wage is paid out of a pool contributed by employers by a levy proportionate to their wages bill, there is little likelihood that they will try to keep on the register a larger number of workers than can normally hope to get jobs. The workers, on the other hand, are no longer so anxious to keep the numbers down ; £4 8s. for a man who does not get a single shift, with the hope of considerably more if he does get taken on for even a modest amount, is better than national insurance benefit and does not involve all the bother and disarrangements of one's usual routine inevitably associated with changing one's occupation.

Size of Dock Labour Register

Until last year, the size of the register has not been a matter of great disagreement, for the docks have been very busy, but the situation has altered and there has appeared the first serious challenge to the new system since it was introduced. The decline in international trade has caused serious unemployment in the docks—16,000 out of a total of 80,000 on the register were out of work in the autumn—and on November 1st the Dock Labour Board raised the levy from 16 to 22½ per cent. This means that employers are now paying five men's wages for four men's work, a heavy burden on an industry which is already in difficulties.

This situation faces the Board with a serious decision. It cannot raise the levy above 25 per cent of wage bills without Government approval, and any increase up to this point will meet with the opposition of the employers. It could, of course, reduce the "sanctioned strength," but this would be firmly opposed by the dockers. There has already been trouble in the ports on account of the introduction of labour-saving machinery which made some workers redundant, and there would certainly be more if the reduction was due to what might prove to be simply a temporary decline in the volume of work.

A tentative step to get over the difficulty was announced last month by the National Dock Labour Board. Men unable to get work at the docks may volunteer to go to other employment without losing their rights as registered dockers. A man who takes advantage of this permission may return to dock work at any time he wishes within a year of leaving ; during the second year he may be recalled if he is needed and must return within six weeks or lose his right to reinstatement. The scheme is to end at the beginning of 1955 and any docker still on the dormant register at January 1, 1955 (i.e. who has gone to another job, but has still retained his right to return) will be put back at once on the live register if he applies.

The scheme has been agreed by employers and unions and is designed to protect the interests of both. It is evidently based on the view that the present decline in dock work is likely to last for some little time, though Sir Walter Monckton, when explaining the scheme in the House, refused to divulge the advice on which the forecasts had presumably been made. But it is entirely voluntary and its success depends on the men's view of the future.

In the dockers' view it was just these ups and downs in the amount of work that the scheme was designed to cope with. What justice can there be, then, they ask, in turning men off at the moment when the scheme might begin to show its real value ? On the other hand, it might be argued that the scheme never intended to confer on a man the inalienable right to either dock work or £4 8s. for life ; but to smooth out the day-to-day, or week-to-week, fluctuations in an industry that is inherently irregular. The real problem is to know how to judge when a temporary fluctuation has become a long-term trend. Or, in other words, how can one reconcile the justifiable demand for some element of security in the life of the individual with the need of the economy for flexibility and adaptability ? Unless imports and exports rapidly expand in volume the National Dock Labour Board will have a very nasty problem on its hands.

The "Closed Shop"

The closed shop controversy has raised its head again and led, last year, to two very interesting disputes, both of which required outside assistance before a settlement could be reached. The first was the result of the action of the Durham County Council, which "thought up a quick one" for getting over the defeat it had sustained in the previous year. In 1951, Durham County Council announced that it would not employ any person who was not a member of his appropriate trade union or professional association —a decree to which all its professional employees at once took exception, and Durham posts were blacklisted by all the professional bodies. Indeed, it was only because the Minister of Education (Mr. George Tomlinson) exercised his powers on the ground that the council, as the local education authority, was not fulfilling the statutory duties laid on it by the Education Acts, that the council gave way in regard to teachers, dentists, doctors and professional engineers. But, in the autumn of that year, it hit back by decreeing that any of its employees who wished to apply for extended sick leave—that is, beyond the normal maximum of six months—must do so through his trade union or professional organisation.

Now, of course, the number of such applications is very small, but the principle of professional freedom is important and the associations were as fully determined not to sit down under this imposition as they had been in the wider controversy. An emergency committee of all the professional bodies concerned, including the Engineers Guild, put forward a proposal that an application for extended sick leave should be put forward through another employee of the council belonging to the same profession as the applicant—a doctor through the M.O.H., for example—(a practice that is common with other local authorities), but the council refused to agree, and the emergency committee asked all the professional journals to boycott any Durham advertisements. This might have led all the Ministers involved to follow the lead given earlier by the Minister of Education and issue directives, but the council forestalled this by reporting the dispute to the Minister of Labour and a Board of Arbitration was set up under the chairmanship of Sir John Foster, K.B.E., Q.C. The question was not whether membership of a professional body should be compulsory or not—that had been settled in the earlier quarrel and the council had lost—but whether this particular rule governing applications for extended sick leave was or was not in conflict with this principle of voluntary membership. After hearing both parties, the Board awarded that the regula-

tions were in conflict with the voluntary principle and should be withdrawn.

The Non-Union Shop

The second dispute showed exactly the same coin, but in reverse. D. C. Thomson and Co., Ltd., is a family business of printers and publishers employing about 2000 persons, mainly in Dundee, but with branch offices in Glasgow, Manchester and London. Before the General Strike of 1926 the company used to negotiate with trade unions and placed no impediment in the way of its workers joining whichever union they liked. At the time of the strike, indeed, it is claimed that 100 per cent of those eligible were, in fact, in unions.

In April, 1926, the firm signed an agreement with the Dundee Typographical Society, one clause of which stipulated that no man should leave regular employment without giving or receiving a full fortnight's notice ; but within a month of signing this agreement there occurred the general strike and a number of Thomson's employees stopped work in sympathy with the miners. The unions stressed the fact that there was no quarrel with Thomsons—it was entirely an expression of sympathy with the miners—and more than half remained at work. But enough came out to cause serious dislocation to the firm's business, and Mr. Thomson, the senior member of the firm, was extremely angry, particularly as it was alleged that the local union official had persuaded the men to come out by grossly misrepresenting the company's attitude. The upshot of all this was that the firm decided to become a non-union business and, after this time, all those who sought re-engagement had to sign a document showing that they had severed connection with the union. At first this applied only to those that had struck, but as time went on this condition was extended to all other members of the firm—technical, editorial and commercial. Those taking on staff were instructed to put the matter clearly before every applicant for work and to exercise no persuasion to get men to leave the union ; but, at the same time, to make it clear that the person, if taken on, would be bound in honour to resign his job if, later, he desired to rejoin the union.

A similar demand was made by other Scottish printing firms, but in the course of time they softened in attitude and, though they refused to negotiate with the unions, they put no bar on their employees joining any organisation they pleased. Thomsons, however, remained adamant and insisted that, as long as everybody knew the conditions their unswerving insistence on the signing of the agreement was a safeguard to both sides.

During the second world war there was an immense increase in union strength in general, and the printing unions suggested the possibility of reopening the discussion. Despite several conciliatory letters they were invariably met with a blunt refusal and the unions, not content to leave matters where they were, began a campaign to recruit new members from amongst Thomson's employees — a policy of permeation.

Towards the end of 1950 matters took a new turn. Two members of the Amalgamated Engineering Union were refused employment because they were unwilling to sign the agreement of non-membership and this gave rise to a publicity campaign against the Thomson attitude — a campaign carried on by unions outside the printing industry, though supported by them. From this time the position became more serious. The unions directed a stream of propaganda towards Thomson's workers ; the firm began to suspect that many of their employees had, in fact, broken their agreement and everybody generally became very suspicious of everybody else.

Matters came to a head when a Mr. Charles, a packer, was dismissed. The firm has since stated that it was because it suspected him of being a unionist—though it had no proof—but it did not give this reason at the time. Its own explanation is that it did not wish to make it difficult for him to get a new job by tying a black label round his neck as a breaker of agreements and a disrupter of harmony and it gave him his two weeks' pay in lieu of notice, as was the practice when dismissing personnel for any reason. A similar happening occurred a little later with a man who felt he had been badly treated in being passed over for promotion and, although after some altercation, it was he who handed in his notice, the firm gave him his two weeks' pay with an additional six weeks' wages for long service. It was this last occurrence which actually precipitated the strike. Feeling ran very high ; there were differences of opinion as to whether the man had resigned or been dismissed ; letters written to the firm were not answered and a number of men decided not to report for duty. They chose a difficult moment ; just when *The Sunday Post* was going to press, and the management announced that men failing to appear by 10 p.m. would be deemed to have given up their jobs. In fact, seventy-seven men, seventy-four of whom were secret members of the union, stayed away.

NATSOPA referred this matter to the Minister of Labour, asserting that these seventy-four men had been wrongly dismissed. Conciliation was tried without success and a court of inquiry, under the Industrial Courts Act, 1919, was set up under the chairmanship of Sir John Foster.

The dispute turned entirely on freedom to join an association. The firm submitted that wages and hours were at least as good as those ruling in the industry and that the conditions of employment were those prevailing in other firms. In addition, the company offered its employees substantial benefits by way of sickness, superannuation, pension and similar schemes. The union admitted the general truth of these statements, but argued that the firm could take no credit for them since it would not have been able to get labour if its terms had not been as good as those of other firms. In one way this was a damaging admission on the part of the union ; for if there was, indeed, adequate alternative employment available, men who voluntarily signed an agreement not to join a union knowing that they had every intention of breaking it immediately could hardly be said to be acting honourably, whilst if they had been desperate for jobs some excuse might have been made for them. The union cannot have it both ways. But this was rather by the way, for the union's chief argument was that, as the company followed the wage and hours agreements reached by collective bargaining it gained all the advantages of the existence of a union whilst preventing the employees from contributing to its support. Nor, insisted the union, was it possible, in reality, for the workers to voice their grievances, as had been claimed, by direct access to the management. The ideal relationship of a family business working in harmony was something of a myth, as was evidenced by the rarity of the occasions on which workers had, over a period of years, actually approached the management.

The court of inquiry, in its report, pointed out that both sides had throughout acted strictly within their legal rights. The firm had the right to lay down the conditions on which employment was offered, so long as men were free to refuse the job on the terms offered, and, generally, the union was within its rights in trying to establish the principle of freedom of association. At the same time, the report made it clear that, whilst the Court could not condone the action of workers who broke their signed agreement, it condemned a requirement by an employer which led to such action by workers whose honourableness in all other matters was not in question. It urged the company to let bygones be bygones —though it used more formal words—and to consider carefully whether it was wise to continue to insist on this undertaking.

Liberty

These two disputes are interesting because they give some idea of where we may be led by this passion for getting everybody neatly shepherded into their particular pens. The unions' desire to have 100 per cent organisation is natural, as is also the irritation on the part of members of a union when they see outsiders sharing in the benefits which they have done nothing to bring into existence. But, if unions wish to give up their voluntary character, as they do when they demand a "closed shop," they cannot balk at the consequences. The refusal to employ any non-member—as in Durham—is just the same in principle as the refusal to employ anybody who is a member—as in Dundee. Both are an infringement of liberty because they introduce into the wage bargain something which is entirely irrelevant to a man's efficiency for the job for which he is being considered. There may be a case for limiting employment in a firm to one or the other—compulsory membership or compulsory non-membership, as the case may be—if it is done by agreement by all concerned. This has been done in many firms for a great many years, when employers have agreed with the unions that only organised workers shall be employed. The employers like to know that there are accredited spokesmen who can speak on behalf of all their workers ; workers like to know that their workmates are fellows in a more general sense and this leads to better industrial relationships. If this is done by agreement of both sides, nobody's freedom is curtailed even though there may be persons who wish it otherwise. It is the same situation as in any democratic community, where the minority must bow to the wishes of the majority until they can persuade them to change the rules.

This fundamental difference between something done by agreement and something done by decree, is not always understood. It happened that I was visiting many of the West Indian Colonies at the time that the Durham dispute was reaching its climax and found that great interest was taken in its development. In these communities trade unions are only just beginning to emerge, and, in order to hurry things up, many of those who are anxious for workers to have the kind of protection of working conditions that unions have won for people here, are ready to cut corners whenever possible. Compulsory membership of a union seemed a good way of reaching the desired goal of enabling workers to have a real say in their working lives, and many people wished employing bodies there would take a leaf out of Durham's book. I remember I was talking to a Labour Commissioner—a very able West Indian—and described to him the lengths to which the N.U.T. declared itself prepared to go in order to preserve the freedom of teachers not to belong to it if they didn't wish to. He threw up his hands

in despair, "I'll never understand the English," he said.

One Occupation, One Union

But even a closed shop by agreement has its dangers, and one, in particular, which has grown in seriousness during recent years. To agree that all should be in organisations that can speak for their interests is very different from specifying that the organisation must be one named one and no other. Indeed, if it became usual to limit membership in one occupation to one union only, it would mean that the union would gain the complete authority over a man's economic fate that used to be possessed by the employer and which the trade union movement grew up to combat. A case which illustrates this point was heard in the early part of last year.

The corn porters in the Port of London have, by long-standing custom, the exclusive right to handle the grain overside from the ships using the port. Mr. Abbott, a foreman corn porter and a member of the executive committee of his union, was angry that, in September, 1947, the committee imposed a cash fine on him and, in the street, immediately after the meeting he assaulted the union official who was convener of the meeting. The assaulted man immediately called another meeting, which decided to remove Mr. Abbott's name from the register, with the result that he could no longer work at his trade in the Port of London. The case was taken to the Court of Appeal, which, early last year, gave its ruling. The majority held that the executive committee had gone beyond its powers, but that since there was no basis of contract between Mr. Abbott and the committee there could be no claim for damages, and the Court could not order that his name should be replaced on the register. Lord Justice Denning disagreed. He argued that, like any member of a club, a union member has an implied contract that his committee will not expel him except in accordance with the rules.

Most trade union officials do not, as far as we know, behave in this high-handed way and deprive a man of his chance to earn a living for reasons that have no relevance to his work. But if the closed shop came to mean more often than, fortunately, it does now, the insistence on membership of one specified union, the power of the union official would be so enormously enhanced that it would be entirely inconsistent with the cherished freedoms of a democratic community.

It is not only petty spite that must be feared. Most union officials are sensible and honest men and would be unlikely to use their power to satisfy personal feelings. But even honest and sensible men find difficulty in remembering that the other fellow may disagree with their policies and yet be as honest and sensible as themselves. The compulsion to belong to one union, and only one, prevents any possibility of those who disagree with the governing body being heard. In Parliament there is Her Majesty's Opposition and in the country there are numerous newspapers of every political colour to act as channels of communication for those who are not in sympathy with the views of the majority. It is only by the freedom to break away from an organisation, if differences of opinion are felt to be sufficiently important, that unionists can find any way of expressing their opposition. A minority in every branch might make a sizeable proportion of the total membership, but it would be invariably outvoted, and the union journal is run by the governing body and can pick and choose what it publishes.

This does not mean that every tiny handful of disaffected persons must be given a representative on the negotiating body; such an arrangement would be impracticable. But if workers have the right to belong to any organisation they choose, with the proviso that only those which have a certain proportion of the eligible total within their fold would be represented in the negotiations, the totalitarian power of the single union would be broken.

Social Insurance

Inflation has led to big changes in social insurance. Two of the main principles recommended by the Beveridge Report for the reorganisation of the various schemes were (1) that the benefits provided should be adequate for subsistence, and (2) that, as the minimum expenses of living are the same whatever the misfortune which has interrupted earning capacity, they should be the same for all vicissitudes. Neither of these principles has, in fact, been maintained, though the original scheme enacted by the National Insurance Act, 1946, contained them both. The rise in prices soon left the insurance benefit below the cost of minimum subsistence and, appalled by the amount of money required to bring all benefits into line, the Government, in 1951, raised the benefit of the old, but left the others as they were. A still further jump in prices has led to second thoughts and the common benefit for all eventualities has once again been established. The Family Allowances and National Insurance Act, passed in June last year, increased the rates of family allowances from 5s. to 8s. a week and raised both contributions and benefits payable under the National Insurance Acts. Unemployment and sickness benefits were increased from 26s. for a single person and 42s. for a married couple to 32s. 6d. and 54s. respectively, which brings them again into line with the retirement pensions which had been raised the year before.

How far do these new rates represent the cost of basic subsistence? Both the Governments responsible for the changes in benefits related the rises to the increase in cost of living as shown by the retail price index; but, as was argued earlier in this article, this does not measure the cost of basic subsistence, but only the change in the money cost of maintaining the pattern of expenditure that was typical of the major part of the community at a given moment of time. People who are out of work or suffering from illness or injury, or those living on retirement pensions, do not, as a rule, spend much on clothes or recreation or household equipment, and increases in the costs of such items of expenditure are irrelevant to their situation. Food and fuel costs—the real essentials of subsistence—have risen much more proportionately than the index in general. This can be seen from the changes introduced by the National Assistance Board into the assistance allowances. The Board is bound to provide for the actual needs of its applicants and has raised its payments to a level which allows for a 46 per cent rise in prices since 1948 (a figure which allows something for the anticipated further rise within the next few months) and, in addition, the Board pays the actual rent of the person it supports. Insurance benefits, on the contrary, have risen only 23 per cent and the beneficiary has to meet his own rental expenses out of them.

There is, of course, a difference between the two kinds of payment. Assistance allowances are financed out of taxation, whilst insurance benefits are paid out of the National Insurance Fund, the main part of which is provided by the contributions of employers and employed. As it is, contributions have been raised to pay for the higher benefits—in the case of male employees, to 5s. 9d. for the worker and 5s. for the employer, and in the case of the self-employed, to 7s. 5d.—and if insurance benefits went up as much as assistance allowances, a very material further increase would be required. Neither worker nor employer would receive this with pleasure.

Even so, the position of the Insurance Fund raises feelings of apprehension in those who are prepared to look a little farther than their own noses. For many years it has been accumulating a surplus, due primarily to the extremely low incidence of unemployment; but with every year the cost of retirement pensions gets heavier and heavier and must continue to do so as the proportion of old people in the community increases. Greater expectation of life, on the one hand, and low birth rates during the first forty years of this century on the other, have created a lop-sided population. Nothing can alter the essential characteristics of this population; it exists. In the course of the next twenty-five years, the cost of retirement pensions (at present rates) will double, whilst the size of the working sections of the population will remain about constant. At present, there are six persons in the contributor class of the community for every person drawing pension on account of age; by 1977, there will be only three. This change in balance means that by 1954–5 expenditure from the National Insurance Fund will begin to outstrip income and will continue to do so at an increasing rate. It is estimated that in five years' time the deficiency will be £100 million a year and that by 1977 it will be about £420 million a year.

A clause in the National Insurance Act, 1946, stipulated that there should be a comprehensive review of the working of the schemes in 1954—next year. The meaning and measurement of basic subsistence and the cost of retirement pensions to a community that persists in regarding sixty-five as the onset of unemployable old age, despite all the advances in medical and social science, are only two of the factors that are likely to give serious headaches to the "reviewers."

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24 Victoria Street, London, S.W.1.

HOSE COUPLINGS (AIR AND WATER), ¼IN TO 1¼IN NOMINAL SIZES

No. 1906 : 1952. This standard covers the following types of hose couplings :—

(1) "Light" series, coned type. These couplings are intended primarily for use with paint spray equipment and other small appliances.

(2) "Medium" series : flat and coned types. These couplings are intended primarily for use on light pneumatic tools in general engineering and allied industries.

(3) "Heavy" series : flat and coned types. These couplings are intended primarily for use on the heavy type pneumatic tools such as rock drills and kindred equipment in the mining and quarrying industries and civil engineering.

These couplings are intended for working pressures not exceeding 150 lb per square inch.

The standard deals with workmanship, interchangeability and hydraulic testing of these couplings. Details of materials and screw threads are also given. B.S.P. Whitworth threads are specified for the "light" and "medium" series of couplings, and the Unified form of thread for the "heavy" series of couplings. Illustrations of the couplings are given, together with full dimensional particulars.

This standard is complementary to B.S. 1782, "Hose Couplings (1½in to 8in Nominal Sizes) Other than Fire Hose Couplings." Price 10s.

Naval Construction in 1952

By RAYMOND V. B. BLACKMAN

No. II—(*Continued from page* 33, *January* 2*nd*)

Other New Naval Vessels

WORK also proceeded during the year on an entirely new design of light warship for seaward defence and, according to the statement of the First Lord of the Admiralty explaining the 1952–53 Navy Estimates, the first of these novel vessels should be completed during the financial year. The new construction programme includes about eighteen of these craft.

The new surveyor ship, "Vidal," was fitted out during 1952 but has not yet been accepted into service. Built at H.M. Dockyard, Chatham, she has an overall length of 315ft, a length between perpendiculars of 297ft and a beam of 40ft, dimensions approximately to those of a destroyer or large frigate. The ship's main propelling machinery consists of four diesel engines driving two shafts through reverse and reduction gear boxes. The engines were designed in conjunction with the Admiralty Engineering Laboratory and the Engineer-in-Chief's Department of the Admiralty, and manufactured in the Royal Dockyard at Chatham. The electrical power is provided at 220V d.c. from diesel-driven generating sets having a total output of 360W. The "Vidal" is the first surveying ship to be equipped with a helicopter flight deck.

One of the surprises of the year was the sudden decision of the Admiralty to cancel the contract for the construction, five months after her keel was laid, of a new naval hospital ship which, it was officially stated, had been begun on February 19, 1952. On July 11th the Admiralty confirmed that the order for the vessel had been cancelled. The ship would have had a displacement of 10,000 tons and would have cost about £2,000,000. She was being built in the Clydeholm yard of Barclay, Curle and Co., Ltd., of Whiteinch, Glasgow, and would have been the first hospital ship for the Royal Navy designed for the purpose from the very beginning. The reason given for the cancellation of the order by the First Lord of the Admiralty, in reply to a Parliamentary question, was because of the need at the present time to devote the limited resources available to improving the fighting efficiency of the Royal Navy.

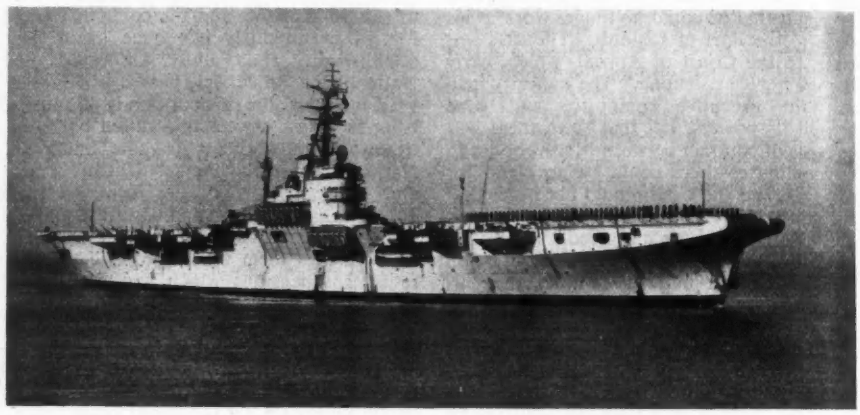
The keel of a small naval hospital ship, which will be used in peacetime as a Royal Yacht for Her Majesty The Queen, was laid at the Clydebank yard of John Brown and Co., Ltd., in June, 1952.

Reconstruction and Modernisation

As distinct from new construction ships, the reconstruction and modernisation of some existing ships and the conversion of others to new or different roles is an important part of the rearmament programme. A considerable amount of modernisation and conversion work was handled by the Royal Dockyards in 1952, although it was necessary to place a good deal of the reconstruction work with commercial yards.

Aircraft Carrier Modernisation

Work continued on the rebuilding of H.M. Aircraft Carrier "Victorious," in H.M. Dockyard, Portsmouth. The "Victorious" was first completed in May, 1941, and she had a nominal displacement of 23,000 tons standard, displacing 29,110 tons at full load. Parsons geared turbines turning three shafts and developing 110,000 s.h.p., gave her a speed of 31 knots. There are all the indications that when the "Victorious" emerges from this reconstruction in about two years' time she will be a much bigger and heavier aircraft carrier than she was formerly. In the 1950–51 Navy Estimates explanatory statement it was said that the "Victorious" would be the first of several such vessels to be modernised to increase their fighting efficiency, but this plan now seems to have been abandoned. Some four years ago it was proposed that her sister ship, "Formidable," should be taken in hand for similar reconstruction and modernisation but the "Victorious" was chosen as the prototype for the rejuvenating process instead. In October, 1952, it was announced by the Admiralty that it had been decided to scrap the fleet aircraft carrier "Formidable," as only a complete modernisation could fit her to operate modern naval aircraft, and this would not be justified now that H.M.S. "Eagle" was in service and H.M.S. "Ark Royal" was building.



British Light Fleet Aircraft Carrier under Modernisation

The light fleet carrier, "Warrior," illustrated above, is in H.M. Dockyard, Devonport, for a less extensive modernisation. It will be recalled that on completion in 1946 the "Warrior" was lent to the Royal Canadian Navy for two years. In 1948–49 she was temporarily equipped with a special experimental flexible landing-deck for operating jet fighters with skids instead of the conventional surface undercarriage with wheels, thus making for safer landings of fast aircraft in a limited space. The flexible deck consisted of a rubber sheet supported by air bags, and it extended from the bows to the barrier forward of the island, being superimposed on the normal flight deck. The after part of the deck was built up to the same level by laying on a light steel structure some 2½ft high.

Cruiser Modernisation

During 1952 work on the modernisation and partial reconstruction of the cruisers "Birmingham," "Newcastle" and "Newfoundland" was completed. Of 9100 tons standard displacement and 12,400 tons full load, the "Birmingham," illustrated opposite, and "Newcastle" are among our oldest operational cruisers, having been completed in 1937. But in many respects they have now become two of the most modernly equipped cruisers ever to have joined the Fleet. The former vertical rectangular bridge structure of each ship has been replaced by a conning-tower with raked profile and curved contour. It is now a streamlined, protected navigating position resembling a fort with no awkward corners. It is air-conditioned and fitted out to the latest requirements of warship design.

In the "Birmingham," which was reconstructed in H.M. Dockyard, Portsmouth, and the "Newcastle," modernised in H.M. Dockyard, Devonport, the height of the former hangars abreast the forefunnel which accommodated two of the three aircraft which each ship carried when originally built, was cut down by one deck and the remains of the hangar structure are now serving the needs of office and domestic accommodation. A new lattice foremast has replaced the former tripod foremast, but the tripod mainmast was retained. The actual main armament of nine 6in guns and the secondary battery of eight 4in weapons have not changed, speaking in terms of calibre and disposition only, but the close-range armament has been modernised and augmented to a score of new 40mm Bofors A.A. pieces. The whole ship is packed with a variety of different kinds of radar sets for locating targets for the various guns. The ship has the greatest amount of radar apparatus ever installed in a cruiser. There are still six 21in torpedo tubes. In both ships the fire control of the guns has been brought up to date with very up to date equipment. The ship's main propelling machinery of eight Admiralty three-drum type boilers supplying steam to a four-shaft arrangement of Parsons geared turbines developing 75,000 s.h.p., equal to a speed of 32 knots, has been retained but overhauled, and the auxiliary machinery has been augmented with two additional turbo-generators installed for increased electrical power and new evaporating plant for making fresh water. After modernisation both ships proceeded on active service in Korean waters.

Extensive modernisation of the "Newfoundland" was completed towards the end of the year. She has been reconstructed at H.M. Dockyard, Devonport, with two lattice, instead of tripod, masts, new model bridge and improved anti-aircraft defences.

Destroyers into Frigates

One purpose of the conversion programme is to turn fleet destroyers into fast anti-submarine frigates and thus to provide a speedy supplement to the current rearmament programme of new construction anti-submarine frigates. These converted ships are

H.M. Cruiser "Birmingham" Recently Modernised

divided into two classes, those fully converted from destroyers into specialised submarine hunter-killer frigates, leaving little semblance to the original destroyer category, and those involving only limited conversion from destroyers into fast anti-submarine frigates, in which the basic layout of the destroyer has been utilised and much of the original appearance of the orthodox destroyer preserved.

During 1952 fourteen more fleet destroyers were or were being converted on similar lines to those of the "Relentless" and "Rocket," converted in 1951. They are the "Rapid" and "Roebuck," their original sister ships and the only two survivors of the "R" class fleet destroyers in the Royal Navy; four of the slightly larger and later units of the "U" class, namely the flotilla leader "Grenville" (extensively damaged in a collision with a 7000-ton Italian merchant ship in October, 1951), and the destroyers "Undaunted," "Indine" and "Urchin"; the five vessels of the "V" class, the "Venus" (Plate 3, Jan. 2nd)—"Verulam," "Vigilant," "Virago" and "Volage," of much the same original design, and three fleet destroyers of the "W" class, the "Wakeful," "Whirlwind" and "Wrangler." When they are taken in hand they are first stripped down to the bare hull, leaving no more than the forecastle and propelling machinery spaces. Building then starts afresh to an entirely new design. The forecastle deck is extended aft to the quarter deck and they are built up one deck higher amidships, extensive use being made of aluminium plates to reduce top weight. A new low-lying superstructure is built on with semi-circular bridge front. A sturdy lattice foremast of new design and the short lattice mainmast is stepped, equidistant between these masts a somewhat squat raked funnel almost amidships. Right aft, in the extended shelter deck, are the loading bays for the two new anti-submarine weapons, arranged *en echelon*.

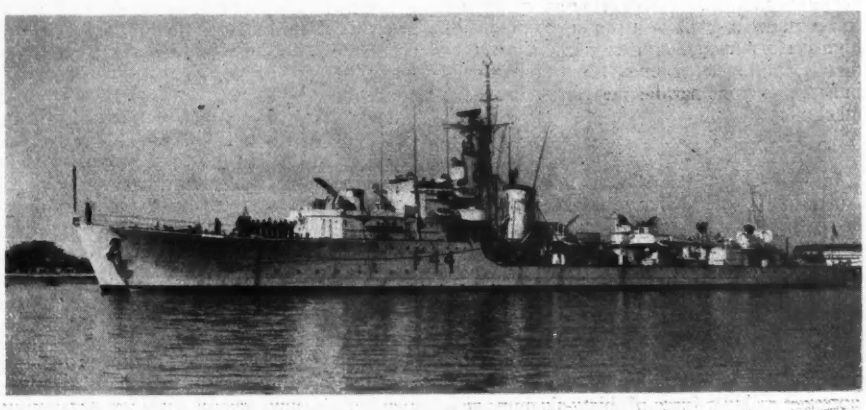
The anti-submarine equipment includes a mortar weapon linked to an Asdic set through an improved electronic fire control system. It can fire a pattern of large projectiles with great accuracy and the projectiles can be automatically set to explode at a predetermined depth. To ensure accurate flight in the air they are fitted with tails, similar to those on bombs, which they closely resemble. The weapon can be trained over a wider arc than was possible with earlier mortars. It is fired electrically when the range is closed and the necessary information from the Asdic set has been automatically and almost instantaneously digested by electronic methods. Increased use of electronics has greatly improved the fire control system, which serves as a link between the Asdic set and the weapon. Experience with the newly converted "Venus," "Verulam" and "Virago" in 1952 has shown that the ships and their equipment are proving well up to expectations and represent a marked advance in anti-submarine frigate design. They originally had a displacement of 1710 tons standard and 2530 tons full load with a length of 362ft 9in, a beam of 35ft 8in and a maximum draught of 16ft. These small destroyer dimensions have been retained together with the original propelling machinery comprising two Admiralty three-drum type boilers and Parsons geared turbines turning two shafts and aggregating 40,000 s.h.p., equal to a designed speed of 36¼ knots and a sea speed of 31¼ knots, so as frigates they are very fast indeed. In addition to the new anti-submarine weapons, the armament of the "full conversion" frigate includes two 4in dual-purpose guns in a twin mounting superfiring over the shelter deck and quarter deck, two 40mm Bofors anti-aircraft weapons surmounting the forward superstructure just before the foremast, and two 21in fixed single torpedo tubes on each beam immediately abaft the mainmast.

In addition to the above sixteen fast anti-submarine frigates of the full conversion type, six destroyers have been or are being modified on a limited basis into fast anti-submarine frigates. The first ship of this simpler form of conversion was H.M.S. "Tenacious" (illustrated below). She was followed in 1952 by three more units of the "T" class, namely, the "Termagent," "Tuscan" and "Tyrian." These vessels, completed in 1943, originally had the same displacement, dimensions, propelling machinery and speed as the "V" class destroyers, but in order to provide the Royal Navy with fast frigates of good anti-submarine qualities more rapidly than the process of full-scale stripping down to the bare hull and rebuilding afresh of the "Rocket" type would allow, their four single 4·7in guns and four of their eight 21in torpedo tubes amidships were suppressed, and a new armament was mounted. They now carry two 4in guns in a twin mounting in "B" position, two squid anti-submarine weapons in "X" position, seven 40mm Bofors A.A. pieces in "Q" and "Y" positions (as in the full conversion there is no weapon in "A" position), and four 21in torpedo tubes before the diminutive pole mainmast.

The other two destroyers taken in hand in 1952 for the simpler form of conversion to fast anti-submarine frigates are the "Orwell" and "Paladin," smaller and older vessels first completed in 1942 and 1941 respectively, with a displacement of 1540 tons standard and 2400 tons full load, an overall length of 345ft, a beam of 35ft and a draught of 15ft 8in; an armament of four old type 4in guns, some smaller A.A. weapons and eight 21in torpedo tubes; and propelling machinery comprising two Admiralty type three-drum boilers and Parsons geared turbines of 36,000 s.h.p., equal to a speed of 34 knots. In recent years the torpedo tubes have been removed and some of the guns suppressed so that they were to a certain extent ready for rearming and modification as frigates.

Submarines

It was stated by the Admiralty during the year that work on two existing submarines had resulted in a material improvement in their underwater speed, and in other qualities. Among the submarines to emerge from reconstruction and conversion in 1952 was H.M.S. "Thermopylæ," first completed in December, 1945. She now presents a streamlined appearance. The bridge, periscopes and all other extraneous features and antennæ have been encased and incorporated in one giant "fin," and she has been practically rebuilt with a cruiser bow, above which has been superimposed a huge dome full of detection equipment. The "Thermopylæ" originally had a displacement of 1321 tons on the surface and 1571 tons submerged with an overall length of 273ft 5in and an extreme beam of 26ft 7in. Diesel engines of 2500



H.M.S. "Tenacious," British Frigate Converted from Destroyer

b.h.p. gave her a surface speed of 15¼ knots, while electric motors of 1450 s.h.p. were equal to a speed of 9 knots under water. She had eleven 21in torpedo tubes and carried a 4in gun, which is now removed.

The development of a new type of fast submarine is continuing satisfactorily and, in addition, a number of submarines of an interim type, with a better performance than any predecessor, are to be built. All possible means of submarine propulsion are under investigation, including systems using nuclear energy and oxygen bearing fuels. Every effort is being made by naval scientists to solve the increasing number of complex problems which arise in providing adequate standards of comfort and habitability in submarines, it is officially stated.

Gunboat Conversion

H.M.S. " Grey Goose," the only survivor in the Royal Navy of the wartime steam gunboats, which were built on the pattern of miniature destroyers for the express purpose of countering German " E-boats," is being given a new lease of life. She is being converted into a gas turbine fast patrol boat. This project had been mooted for the last four or five years while she was laid up in Haslar Creek, but in 1952 she was moved to the Portchester shipyard of Vospers, Ltd., to be taken in hand for modification, and Rolls-Royce, Ltd., has manufactured two gas turbine propulsion units of 6000 h.p. for her. The " Grey Goose " was built by J. Samuel White and Co., Ltd., Cowes, in 1941–42. She had a displacement of about 205 tons, increased to 260 tons at full load with an overall length of 145ft 6in, a beam of only 20ft, and a shallow draught of little more than 5ft. She carried a 3in gun and ten smaller weapons and anti-aircraft pieces as well as two 21in torpedo tubes. Single reduction geared steam turbines of the " Metrovick " type, developing 8000 s.h.p., gave her a speed of 35 knots. With low-lying gas turbines she will be much less vulnerable to damage than she was with a lightweight boiler which could be pierced by machine gun shell.

Research and Development

Concurrently with the above new construction, modernisation and conversion programmes, research in the various fields of naval ship construction has enabled the Admiralty to design with confidence ships' structures to closer margins of strength than would otherwise be possible. Lighter materials have been embodied in the designs of ships' structures where this has been found to be advantageous. The saving in hull weight resulting from these improvements has been used to increase fighting efficiency. Researches in the hydrodynamical field have led to improvements in propulsive efficiency, in ability to manœuvre, and in better seakeeping qualities. Good progress continued to be made in 1952 with the development of high-performance steam engines, lightweight diesels, and gas turbines for warship propulsion, and in parallel design for auxiliary machinery.

Australia

In 1952 £A137,000,000 was allocated as the Australian Navy's share of the money to be spent on a three-year defence programme, under which the naval building effort will be greatly expanded. The new naval construction work announced in 1952 included three boom working vessels, four coastal minesweepers and four seaward defence boats. The naval programme already provided for the establishment of a strong and compact striking force of thirty-six ships with a reserve of eighty vessels, capable of operating independently as a task force or in co-operation with Allied naval forces. It is intended that the Royal Australian Navy will have two aircraft carriers, three cruisers, nine destroyers, eleven fast frigates, thirty-two minesweepers and forty-five other vessels.

Early in 1952 the Australian Prime Minister announced that the completion of H.M.A.S. " Melbourne " (ex-H.M.S. " Majestic "), the second aircraft carrier intended for the Royal Australian Navy, had been postponed while she underwent modifications mainly concerned with the installation of an improved type of catapult apparatus. This ship is being built in Great Britain by Vickers-Armstrongs, Ltd., Barrow. The " Majestic " was laid down on April 15, 1943, and launched on February 28, 1945. From time to time, since she was transferred as an unfinished ship to the Australian Government, various estimates have been made of her date of completion, which was originally scheduled for March, 1950. She will not now be ready for trials before late 1953 or early 1954 owing to constructional delays and to modifications in the design to allow her to operate jet aircraft and new anti-submarine aircraft. She was originally intended to be an identical sister ship of Australia's first aircraft carrier, H.M.A.S. " Sydney " (ex-H.M.S. " Terrible") with a displacement of 14,000 tons standard and 19,550 tons full load ; of H.M.A.S. " Magnificent " in the Royal Canadian Navy ; and of H.M.S. " Hercules," " Leviathan " and " Powerful," described earlier under Great Britain.

Towards the end of 1952 the light cruiser " Hobart," the modernisation of which was begun at Garden Island Dockyard, was taken in hand at Newcastle, New South Wales, for structural alterations to be made. The only surviving cruiser of her type, the " Hobart " (ex-" Apollo ") was completed in January, 1936, and acquired from the Royal Navy in 1938. She has a displacement of 7105 tons standard and 9420 tons full load, an armament including six 6in guns, eight 4in A.A. weapons and eight 21in torpedo tubes, and propelling machinery comprising four Admiralty three-drum type boilers and four sets of Parsons geared turbines developing 72,000 s.h.p., equal to a speed of 32½ knots.

The first of Australia's four very large destroyers under construction was launched from the Cockatoo Island Dockyard, Sydney, and named " Voyager " on March 1, 1952, when a sister ship to be named " Vendetta " immediately commenced assembly in the same yard. Two other vessels of the same class are under construction at H.M.A. Naval Dockyard, Williamstown, the one to be named " Vampire " having been laid down on July 4, 1949, and the one to be named " Waterhen " having been begun in December, 1952. These ships, all ordered in 1946, are of a design similar to that of the " Daring" class, now coming into service in the Royal Navy, but will be modified to suit Australian conditions.

The " Voyager," which was laid down on October 10, 1949, is officially described as the first Australian all-welded ship. She is stated to have been built in prefabricated sections and assembled on the slipway from which she was launched. It is expected that she will be completed by September, 1954. All four ships will have a displacement of 2610 tons standard and 3700 tons full load with the same dimensions and armament as the " Daring " class built in Great Britain, described earlier. The main propelling machinery comprises a two-shaft arrangement of Parsons geared turbines developing 54,000 s.h.p., equal to a designed speed of 34¾ knots and giving a sea speed of about 30½ knots.

A follow-up building programme of six fast anti-submarine frigates of modern design calls for vessels of the destroyer type, but in which the capacity for hunting and killing submarines has been the principal factor in determining the provision of weapons and equipment. Of 2000 tons displacement, they will carry several small-calibre guns and squid type anti-submarine weapons at a speed of about 30 knots. Three are to be built at the Cockatoo Island Dockyard, Sydney, and three by the Williamstown Naval Dockyard, Melbourne, at a cost of £2,000,000 each.

The modernisation of the " Tribal " class destroyer " Arunta " as an anti-submarine escort destroyer has been completed. Her sister ship " Warramunga " is to be modernised in the same way. The conversion of the remaining vessel of the class, the " Bataan," has been authorised. All three vessels, completed by the Cockatoo Docks and Engineering Company Pty., Ltd., in 1942–45, had a displacement of 1970 tons standard and 2675 tons full load and carried six 4·7in guns, two 4in weapons, fourteen smaller A.A. pieces, and four 21in torpedo tubes at a designed speed of 36½ knots, obtained from Parsons geared turbines of 44,000 s.h.p., taking steam from three Admiralty three-drum boilers.

Work was started in 1952 on four of the five " Q " class fleet destroyers, of which the conversion to fast anti-submarine frigates was authorised when they were permanently transferred from Great Britain. The " Quadrant," " Quality," " Queenborough," " Quiberon," and " Quickmatch " are to be reconstructed similarly to the " Relentless " and " Rocket " in the Royal Navy. When first completed in 1942 they had a displacement of 1705 tons, increased to 2425 tons at full load and Parsons geared turbines of 40,000 s.h.p., designed for a speed of 36¾ knots. The conversions are being carried out at Cockatoo Island and Williamstown dockyards at a cost of £A400,000 per ship.

Early in 1952 it was officially announced that the Australian Government had approved the construction of fourteen small coastal defence vessels for the R.A.N. They comprise four coastal minesweepers, four seaward defence boats, three boom-working vessels, a self-propelled oil-fuel lighter, and two deperming lighters, to be used with degaussing ranges to counteract the effect of magnetic mines. Tenders for the hulls of the coastal minesweepers and seaward defence vessels would, it was stated, be invited from private yards, but the main engines and major items of equipment would be ordered in the United Kingdom through the Admiralty.

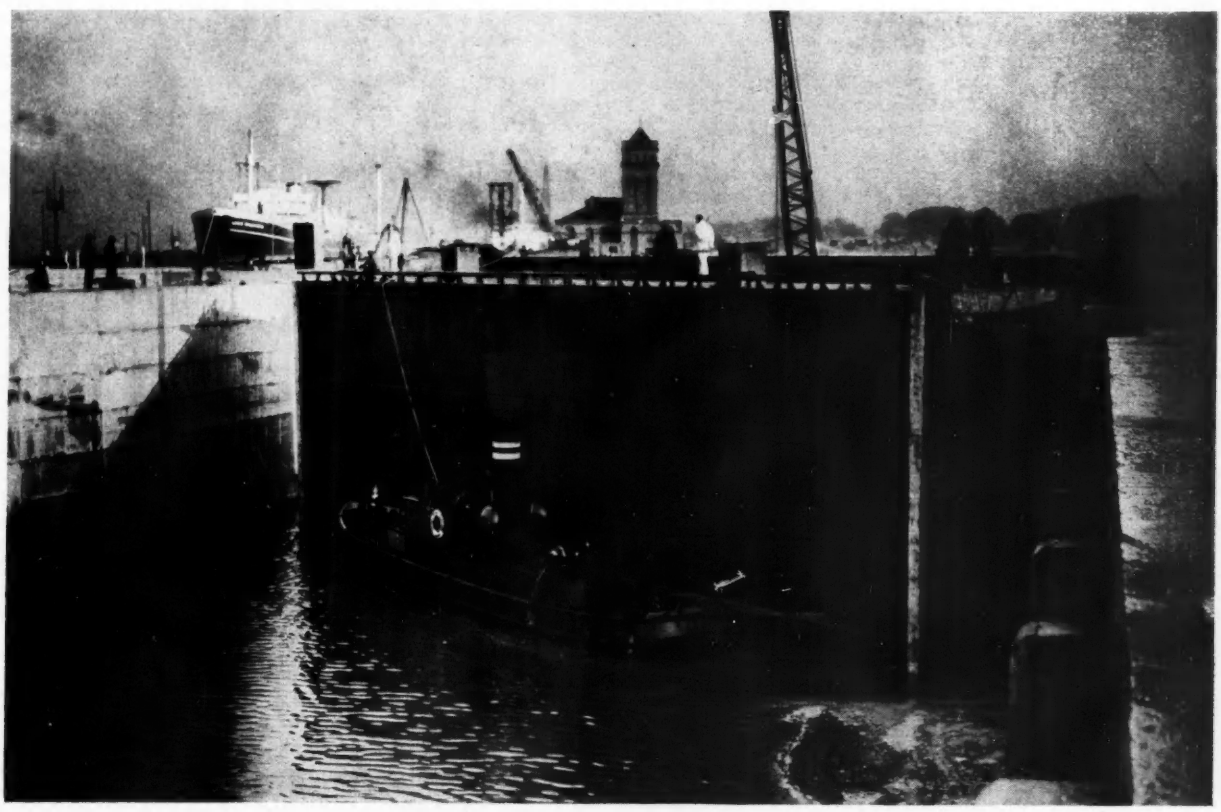
(*To be continued*)

Cutting Fluids.—The Esso Petroleum Company, Ltd., 32, Queen Anne's Gate, London, S.W.1, has issued an interesting booklet entitled " Cutting Fluids." The book deals in some detail with the functions of a cutting fluid, soluble oils, "straight" cutting oils selection of a cutting fluid, application and use, cutting fluids and dermatitis and, finally, " Esso " cutting fluids.

I.E.E. Benevolent Fund.—An appeal for contributions to the Institution of Electrical Engineers' Benevolent Fund has been made by Colonel B. H. Leeson, president of the Institution. The appeal points out that recent increases in death duties and taxation have caused a decline in the value of legacies and donations to the fund. Annual subscriptions have also decreased, but the claims on the fund are growing, and last year expenditure exceeded income by over £2500. Sixteen houses have been completed on " The Chesters " estate to provide homes for beneficiaries who would otherwise be forced to live in unsuitable surroundings. The remaining ten houses are not yet completed, for, although the sum of £42,000 has been subscribed to the Homes Fund, a further £10,000 is urgently required.

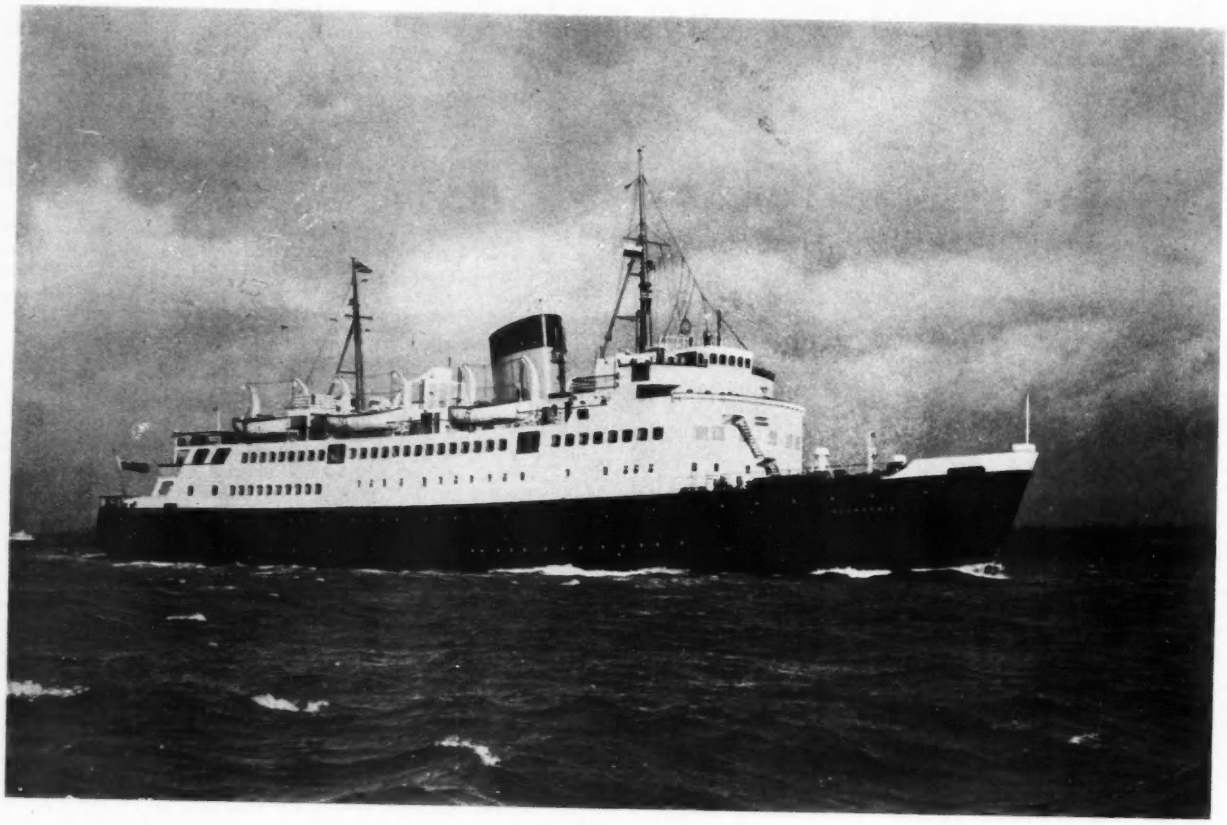
CIVIL ENGINEERING IN 1952

Benevean Dam of the North of Scotland Hydro-Electric Board

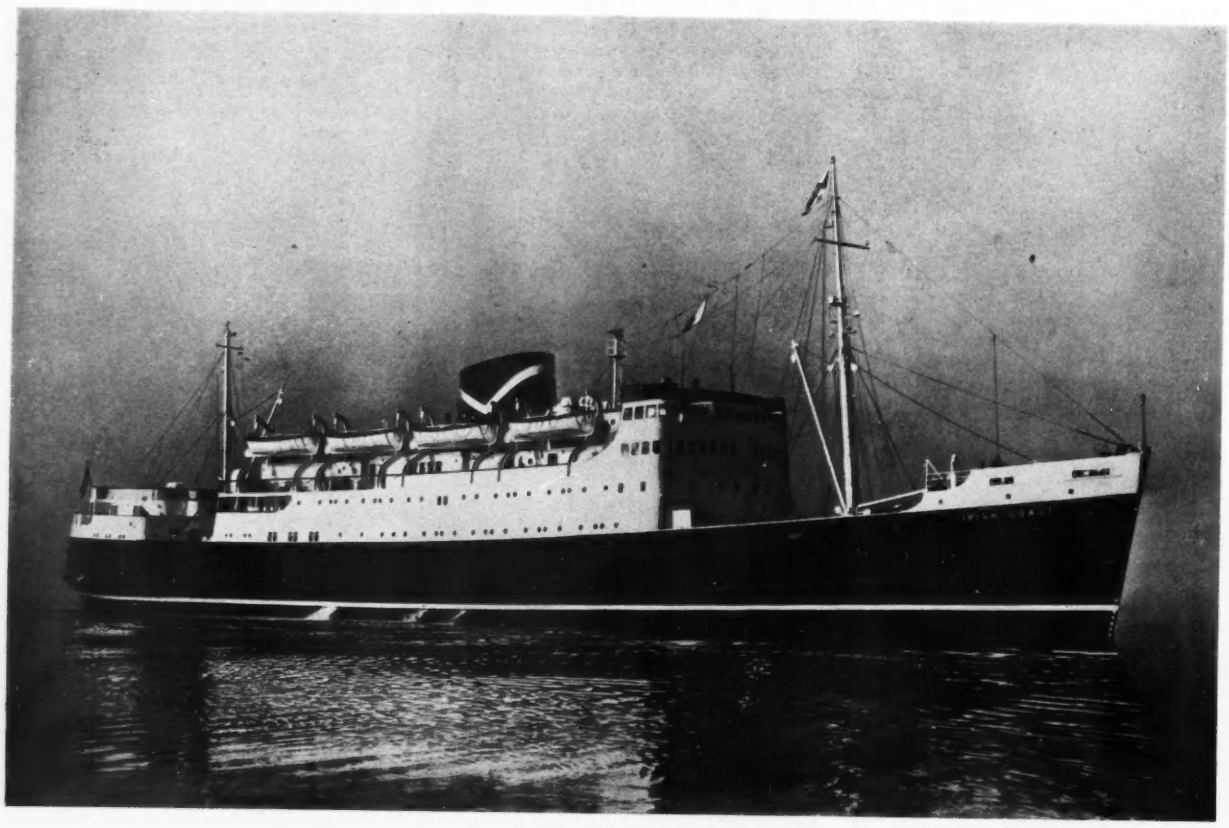


Positioning Caisson in Entrance Lock—Eastham Oil Dock

CROSS CHANNEL SHIPS OF 1952



British Railways "Normannia"



Coast Lines M.V. "Irish Coast"

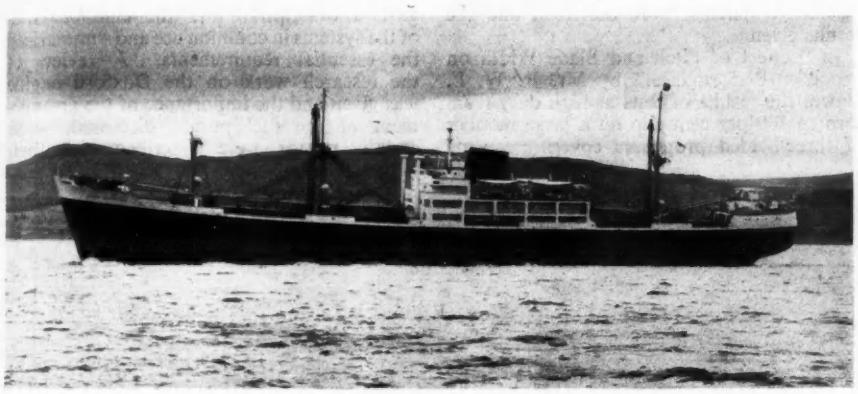
Shipbuilding and Marine Engineering in 1952

No. II—(*Continued from page* 19, *January* 2*nd*)

TECHNICAL PAPERS

MANY important papers dealing with ship design and construction and marine engineering problems were read before the various technical societies during the year.

Consideration of the structural strength problem was the subject of a number of papers and an overall picture of the position was outlined by Mr. James Turnbull in his paper, " Longitudinal Strength—A Review of Some Recent Developments," read at the Institution of Naval Architects Summer Meeting. Mr. Turnbull referred to the comparison made between the tankers " Neverita " (welded) and the " Newcombia " (riveted) and the dry cargo ships



Motor Vessel " Clan Macinnes "

" Ocean Vulcan " and " Clan Alpine." Vertical and horizontal bending and slamming stresses were discussed together with stress ranges and emphasis laid on the failures probably due to poor loading. Another paper read before the Institution of Naval Architects was " Structural Strength Investigations on Destroyer 'Albuera'," given by Mr. D. W. Lang and Mr. W. G. Warren, in which the full-scale strength experiments carried out on a riveted destroyer were described, particularly Trial III, in which the hogging moment was increased until structural failure occurred.

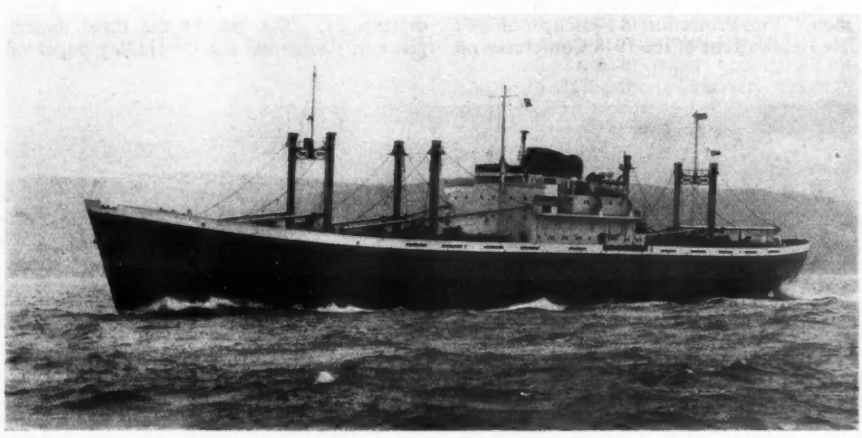
In their paper, read before the Institution of Engineers and Shipbuilders in Scotland, " Ship Structural Members—Part V," Mr. A. G. Hadjispyron and Mr. H. Lackenby gave the results of further investigations at Glengarnock on the strength and stiffness of ship's structural members, namely, 9in and 12in sections in association with plating. The effect of several variables such as bracketed and unbracketed end connections and the cutting of scallops and slots in the stiffener webs of welded stiffeners, was assessed. " The Structural Behaviour of the Main Engine Seatings and Bedplate in a Cargo Ship Under Static Bending Tests," was presented by Mr. A. J. Johnson, B.Sc., and Mr. J. E. Richards, B.Sc. (Eng.), Ph.D., before the North-East Coast Institution of Engineers and Shipbuilders. The results were given of an investigation into the flexure of the bedplate and seatings of a triple expansion steam engine subjected to static bending tests, together with details of the instrumentation and testing technique. Vertical deflection of the bedplate was shown to be twice that calculated for the flexure of the ship girder over the same length. Read before the same Institution was " A Study of the Cause of Some Rudder Failures," by Mr. T. W. Bunyan, which gave the results of a study of the vibration characteristics of rudders as a cause of certain failures.

Dr. G. Hughes read his paper, " Frictional Resistance of Smooth Plane Surfaces in Turbulent Flow—New Data and a Survey of Existing Data," at the Spring Meetings of the Institution of Naval Architects, and gave the results of new experiments, together with a survey of existing data. These made a consistent picture, there being no single friction line but a family of lines varying with the length/breadth ratio. At the Autumn Meeting of the Institution, Professor E. V. Telfer read a paper entitled " Ship-Model Correlation," which noted the errors in power prediction caused by the coincidence of the use of the fully turbulent model, the smooth welded hull and diesel engine propulsion associated with low pitch-ratio propellers. Resistance correlation was considered and ship thrust deduction determination examined and the relationships established were considered in association with the " Simon Bolivar." Another paper concerned with the powering of ships was " Estimation of Ship's Engine Power from Model Experiment Results," presented before the North-East Coast Institution of Engineers and Shipbuilders, in which Mr. J. L. Kent, C.B.E., discussed the possible errors of ship trial data and explained the methods used to predict ship performance. A new method of predicting from model results was described and comparison made between the results of the prediction methods and the trials.

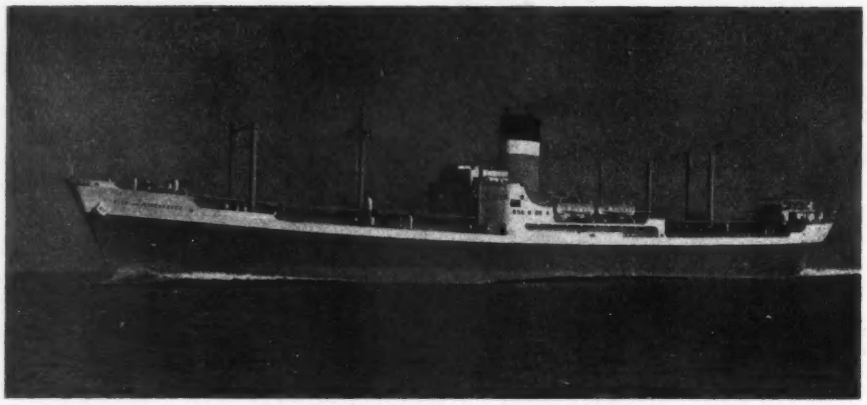
" On the Acceleration of Ships " was the title of the paper delivered before the Institution of Engineers and Shipbuilders in Scotland, by Mr. H. Lackenby, who discussed the development of calculation methods for determining the time and distance required by a ship to attain a desired speed. A paper, " Simplified Launching Calculations," was given before the same Institution by Mr. A. Silverleaf, and described a method for rapidly deriving launch curves for any conditions. Other launch factors discussed were stern lift conditions and stability. Another paper, " Considering Dredging Craft," by Mr. D. W. Low, O.B.E., emphasised the dynamic function of the dredge and the mechanical implications to suit varying conditions of service. Progress during the last fifty years was reviewed and descriptions of many dredges were given.

Among the papers read before the Institution of Naval Architects was " Merchant Ship Design : A Thought for the Future," by Sir Wilfred Ayre, who discussed changes in design to meet the requirements of sea transport as influenced by changes in economic standards. Mr. Norman M. Hunter directed attention to technical developments in his paper, " Changes in Ship Construction Methods, 1850 to 1950," and in " High-Powered Single-Screw Cargo Liners," Mr. W. H. Dickie discussed the form and model tests of a particular class of vessel and gave detail design particulars, performance and construction of the double-reduction geared turbine machinery adopted. The upper permissible limits of thermal environment and the need for the practical method of predicting tropical thermal conditions, before a ship leaves home waters, was discussed and a monogram was presented for the prediction of effective temperature on mess decks, by Mr. J. A. B. Gray and Mr. F. E. Smith, in their paper, " Prediction of Thermal Conditions in H.M. Ships in Tropical Waters." In his paper, " Britain's Deep Sea Liner Trade, 1945–1951, and Some Random Thoughts," Mr. Basil Sanderson discussed the problems facing the liner companies, such as making good war losses, replacing obsolescent vessels, taxation and finding capital for new construction.

Of interest to the shipowner was Mr.



Motor Vessel " Windsor "



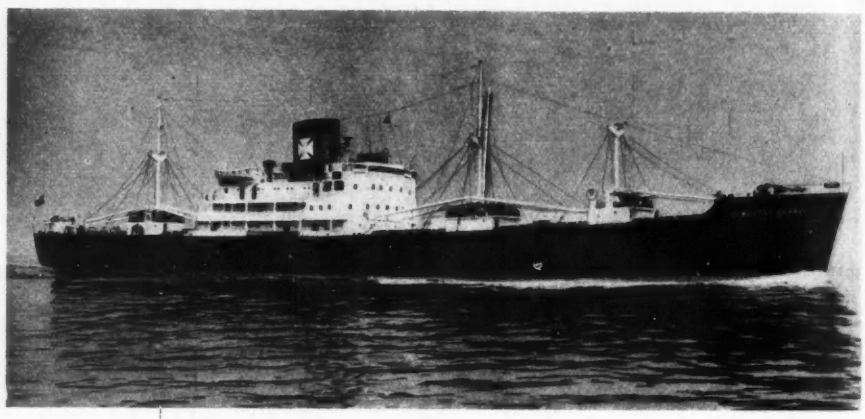
Steamship " City of Winchester "

W. McClement's paper, " Moisture Damage to Cargoes," read before the North-East Coast Institution of Engineers and Shipbuilders, which examined the extent and prevalence of moisture damage and presented data on the properties of commodities of a hygroscopic nature with reference to the requirements for efficient sea carriage. Another paper read at Newcastle upon Tyne was " Fuelling at Sea," by Mr. I. McD. Black, which was mainly of naval interest and described the evolutions of the practice of fuelling at sea since the first trials. The various transfer systems dealt with were the stirrup method, the hose hawser method, the Aston method, and also by derrick rig and jack stay.

Last year the Institution of Naval Architects held its Autumn Meeting in Italy at the invitation of the Associazioni Italiana di Tecnica Navale, the meeting opened in Genoa and the delegates subsequently visited Rome and Naples. At Genoa five papers were presented, including " Longitudinal Strength : A Review of Some Recent Developments," by Mr. J. Turnbull, to which we have already referred, and this was followed by " Six Recent Atlantic Liners," by Lieut.-General E. De Vito. In this paper statistical comparison was made of the displacements, speeds, linear dimensions and hull weights of six liners and the limitations placed on future evolution by physical factors were mentioned. Mention has already been made of " Ship-Model Correlation," by Professor E. V. Telfer and, in the fourth paper, " Measurement of Vibrations," Dr. Ing. Giovanni Villa discussed modern methods of electric and electronic measurement and examined the different systems of measuring ship vibration. The results of tests were given to illustrate the capabilities of certain equipment of single-channel and of either six or twelve channels. The closing paper at Genoa, " Fire Protection in Passenger Ships : Some Implications of the 1948 Conference on Safety of Life at Sea, with Particular Reference to Aluminium Structures," was read by Mr. J. Venus and Dr. E. C. B. Corlett, and discussed the effect of the requirements upon aluminium superstructures. Various " A " class and " B " class tests, using different insulation systems, were described and the results given.

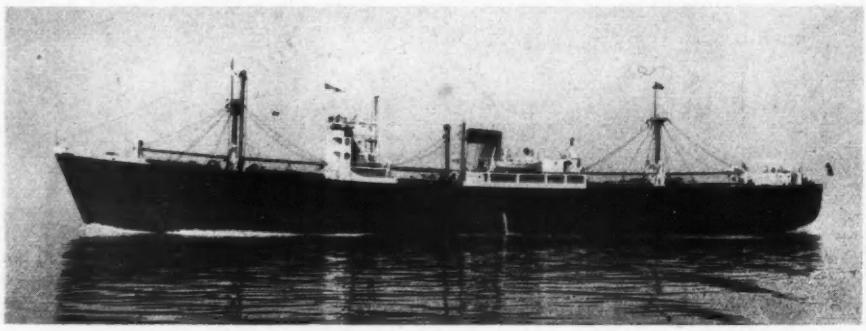
In " Effect of Pitch and Blade Width on Propeller Performance," by Mr. R. W. L. Gawn, the results of tests at high duty from zero to 100 per cent slip on a large number of three-bladed propellers covering a wide range of pitch ratio, and blade area ratio, were given. Dr. Ing. Professor A. Servello, in his paper, " Principal Characteristics of Warship Design," reviewed the practical difficulties in the formulation of approximate rules for guidance in warship design and developed formulæ for obtaining the main dimensions. The last of the three papers given in Rome and the concluding paper of the Conference, was " An Investigation into the Motions of Ships at Sea," by Mr. A. J. Williams. A general description was given of the trials carried out in four warships and the problem of instrumentation discussed while interim results of the trials were recorded with particular reference to rolling.

" The Generation of Gas Bubbles at the Shrinkage Boundaries of Built-up Crankshafts for Diesel Engines " was the title of a paper presented at the Spring Meetings of the Institution of Naval Architects, in which the authors, Mr. Shoichi Amari and Mr. Eiji Ando, expressed three conclusions resulting from the research into the problem of the minute bubbles observed at the shrinkage boundaries of a built-up crankshaft. They also sought the reasons for the occurrence of bubbling phenomenon in crankshafts manufactured in Japan and the non-occurrence in those manufactured in Europe. In a paper read before the North-East Coast Institution of Engineers and Shipbuilders entitled " Fuel Injection Systems for Large Marine Oil Engines," an abstract of which appeared in our issue of February 29th last year, Mr. P. Jackson gave a description and the characteristics of the systems in common use and summarised the essential requirements. A review of the research work on the Doxford engine was given and the importance of the arrangement of the fuel pumps discussed, while certain pumps were described and their influence on engine construction examined. " Springs " was the title of a paper given to the same institution by Mr. W. E. Frost.



Motor Vessel " Oswestry Grange "

Among the papers read before the Diesel Engine User's Association was " Recent Experiences in the Lubrication of Oil Engines " in which Mr. L. J. Izard dealt with field experiences in the lubrication of all kinds of oil engines and particularly referred to the use of lubricating oils containing additives. In another paper, of which an abstract was given in THE ENGINEER of March 28, 1952, Mr. A. K. Bruce discussed the internal combustion engine from the user's point of view. Mr. C. H. Bradbury, in his paper, " Torsional Vibration in Diesel Engines—Some Observations and Practical Aspects," briefly surveyed the subject, discussed various systems and dealt with questions concerning stresses, amplitude, frequency, resonance, damping and control of critical speeds. Another paper concerning vibrations was read by Mr. A. E. Fothergill, before the Institution of Engineers and shipbuilders in Scotland, entitled " Vibrations in Marine Engineering." The author surveyed the vibrations affecting the main machinery and hull and then discussed



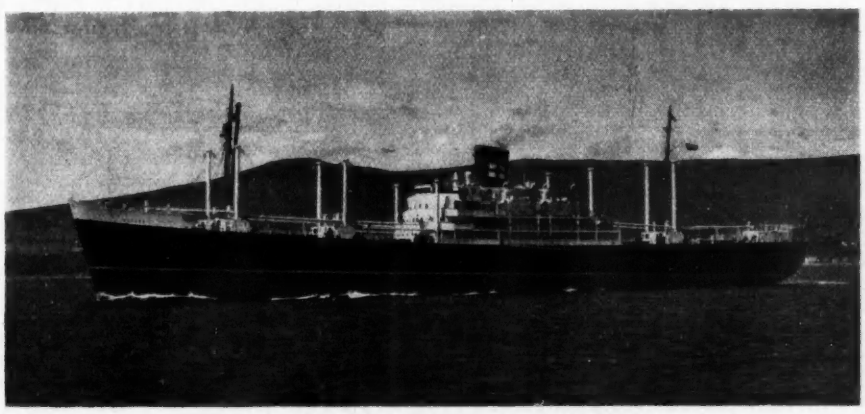
Motor Vessel " Flowergate "

various aspects of the problems involved, including hull vibration periods, torsional vibrations in machinery, hull vibration excited by engines and longitudinal vibration of the shafting system.

A number of papers were read before the Institute of Marine Engineers during the year. Mr. F. J. Mayor, in his paper, "Diesel Hydraulic Propulsion," an abstract of which was published in our issue of January 25, 1952, described the diesel-hydraulic propulsion system installed in a Thames tug and gave the operational results as recorded over a period of two years. "Fuels for Use in Marine Auxiliary Engines" was the title of the paper in which Mr. C. D. Brewer discussed the extension of the use of the heavy grade of fuel in main diesel engines to auxiliary compression ignition engines and reviewed the more important factors which have to be taken into account. Data, derived from observations made in the laboratory and in service were presented and showed that the size of engine greatly affected durability and maintenance costs. In our issues of March 14th and 21st of last year we published an extract of a paper, by Mr. H. N. G. Allen and Mr. T. P. Jones, entitled "Epicyclic Gears," in which the authors surveyed the historical background of epicyclic gearing development and discussed the basic design of some well tried forms likely to appeal to marine engineers.

In his paper, "Steam Pipe Materials for Advanced Steam Conditions," Mr. R. W. Grancher discussed the problems regarding the choice of suitable materials caused by higher steam temperatures and pressures. Four steels, covering a temperature range up to 1050 deg. Fah., were described and the main requirements were stated to be resistance to creep and corrosion, stability of microstructure and suitability for manufacture and welding. The difficulties experienced with gas air heaters were commented on and a case made out for the use of a steam air preheater in conjunction with an economiser in a paper entitled "Steam Air Heaters for Marine Water-tube Boilers," given by Mr. W. J. S. Glass, who also recorded the results of three years' use of steam air preheaters fitted in five ships. Under the title "The Strength of Large Bolts Subjected to Cyclic Loading," Mr. B. Taylor considered the two factors influencing the strength of a bolted assembly and the effect of prestressing of the bolts while some attention was devoted to the results of fatigue tests carried out on 3in and 1in bolts. At the end of the year a symposium of fifteen short papers was read on "Some Unusual Ship and Machinery Defects, Their Investigation and Cure."

(*To be continued*)



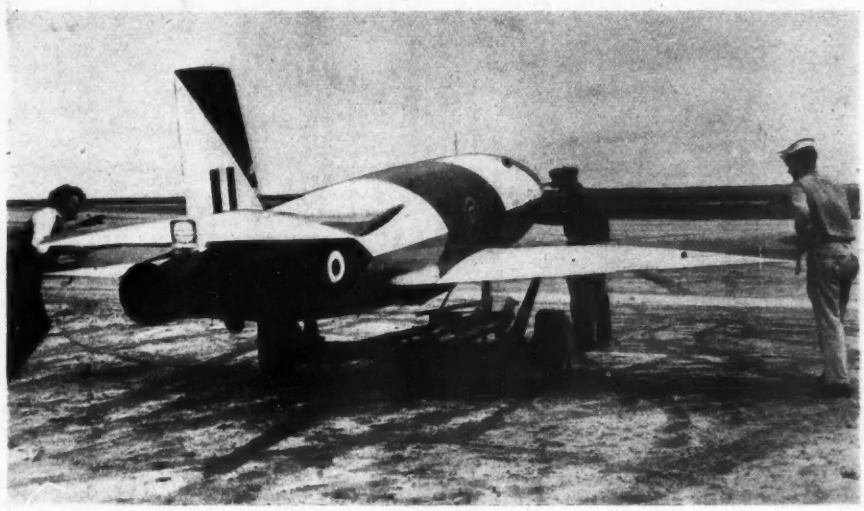
Motor Vessel "Surrey"

Aeronautics in 1952

No. II—(*Continued from page 26, January 2nd*)

THE present pace of military aircraft development is not tempered by economic considerations nor restricted by safety factors to the extent of the civil airliner; consequently the prospects of a respite in the realm of high subsonic speeds for military aircraft threaten to be brief. Already, in the United States, tentative excursions into the supersonic speed range have been accomplished on a piloted rocket propelled straight-wing aircraft, and speeds in the region of 1300 m.p.h. at heights up to 60,000ft have been regularly attained. In this country as yet there is no available information on the development of piloted supersonic aircraft and for obvious reasons little technical data has been released on the development of guided weapons. Significant comment, however, was made by the Minister of Supply last August on the occasion of his visit to some guided rocket trials at the Ministry of Supply's experimental station at Aberporth. The Minister, in referring to these weapons, stated that they constituted "a new industry—the guided rocket industry," and he disclosed that over 100 firms were engaged in this enterprise. Our illustrations show two of the vehicles which are being developed at the British rocket range at Woomera, 250 miles north of Adelaide, in Australia. The first is a pilotless aircraft fitted with an expendable Armstrong-Siddeley turbo-jet engine and made with metals appropriate to its expectation of life. It employs a jettisonable launching carriage and is landed on a belly skid. The nature of the vehicle in our second illustration is more apparent; it shows the remote launching of a rocket from its platform.

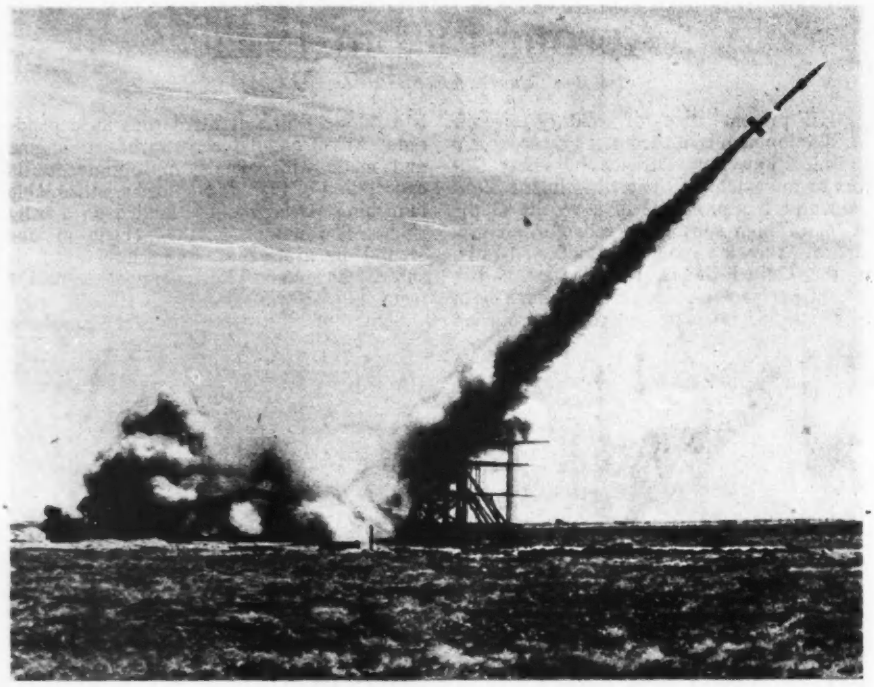
Some of the heat transfer problems occurring in certain rocket motors where combustion temperatures of 3000 deg. Cent. and pressures of 20 atmospheres may obtain, were mentioned in our issue of October 3rd.



A Pilotless Aircraft

We also reported during the year some developments by the Bristol Aeroplane Company, Ltd., of the ramjet—a prime mover of which the thermodynamic and propulsive characteristics can only be properly exploited at supersonic speeds. Overleaf we illustrate a vehicle for testing this unit, shortly after take-off and still in company with its tandem booster rockets by which it is accelerated to the initial supersonic speeds required.

However imminent the establishment of supersonic guided weapons may be, or however important their role, aeronautical interest seemed to have remained firmly on the development of piloted near-sonic and transonic fighter and bomber aircraft. Attention was sharply focused on the delta configuration, particularly in this country, where a bomber and multi-purpose fighter with this profile are in super priority production. In December, however, came yet another wing profile—the "crescent wing" fitted to the "Victor" bomber, (illustrated overleaf) which Handley Page, Ltd., the makers, claim combines the aerodynamic and operational merits of delta, swept and razor-thin straight wings without any of their disadvantages. Although the conception of the delta profile is said to be of German origin, its successful and extensive development up to aircraft the size and weight of the "Javelin" and "Vulcan" aircraft, involving as that did the solution of many new inherent difficulties, particularly of control, is essentially a British achievement, and one largely associated with A. V. Roe and Co., Ltd. There are now flying several other small prototype delta



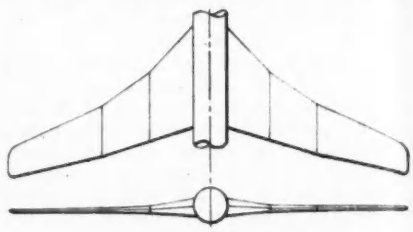
Rocket Launching

aircraft on the Continent and in America, the "Convair" XF2Y-1 delta hydro-ski fighter was recently announced. It has two Pratt and Whitney J57 engines of over 10,000 lb static thrust each.

Whilst the delta plan-form was primarily claimed to have advantages at high subsonic and transonic speeds, it has also demonstrated remarkably stable characteristics at low speeds. The bomber version, which is to be placed in quantity production, has four Rolls-Royce "Avon" engines and is the first delta-wing aircraft to fly without any tailplane whatsoever, thus exploiting an inherent property of its wing profile. Neither has it been thought necessary to equip this version with flaps and in view of these two factors, the speeds to which this aircraft was reduced during some sustained low-level turns at the S.B.A.C. flying display last year were all the more astonishing.

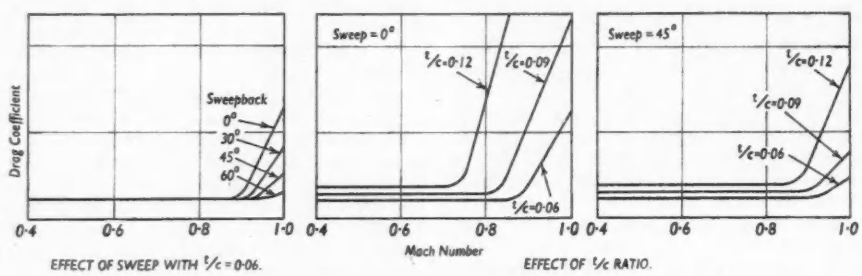
The susceptibility of a delta-wing aircraft to spin and particularly its ability to recover, with or without a tailplane, were conditions which at one time had not been fully investigated. The fact that the "Javelin" has at the present stage a tailplane suggests that in the fighter role the situations which it might encounter in operation, particularly in the transonic region, are still thought to make a tailplane desirable not only for the spinning case but to combat also the changes of trim that can occur at the upper limit of its speed range. Such conditions are presumably not thought to arise with the less arduous manœuvring requirements involved in bombing operations.

There is said to be still a division of opinion, however, in this country as to the relative merits of this plan-form and the swept wing



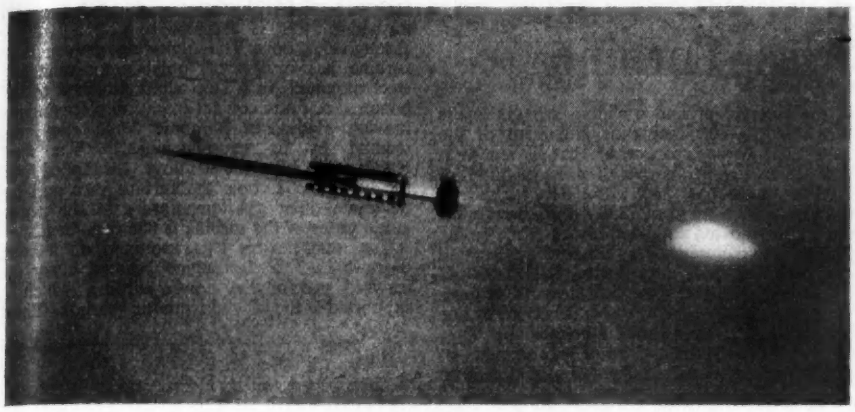
The Crescent Wing Profile

configuration exemplified by the Vickers "Valiant" bomber. That research continues with this latter configuration is evident by the recent announcement of a variable swept wing research aircraft, illustrated opposite. The heavily swept wing has generally been regarded as exhibiting undesirable characteristics at the lower speeds required for landing. This characteristic could be overcome—admittedly with the introduction of engineering problems and a weight penalty—by hinging the wings so that the angle of sweep could be reduced in the air prior to landing. Although this present research aircraft has an adjustable swept wing it can only be so adjusted on the ground and it is stated that the aircraft is to be used for low-speed investigations of swept-back wings. It is the only swept aircraft in this country to be capable of assuming a sweep back of the chord line of as much as 50 deg. It does not appear from the illustration that the undercarriage is retractable, and it would seem that the leg connection has to permit the orientation of the leg and wheel for each angle of sweep investigated. The "S.B/5," as it is known, is made by Short Brothers and



Effect of Sweep and t/c Ratio on Drag

The Handley Page "Victor" Bomber



Ramjet Test Vehicle in Flight

Harland, Ltd., Belfast, whose chief designer, Mr. Keith-Lucas, was the author of a paper entitled " The Shape of Wings to Come," which was read during the British Association meetings in Belfast last year.

The Handley Page " Victor," which at present has four "Sapphire " turbo-jets, was released from the secret list on Christmas Eve. A number of this aircraft was ordered " off the drawing-board " and it has now super-priority production status. The wing drag characteristic curves reproduced opposite illustrate the influence of aspect ratio, thickness/chord ratio and angle of sweepback on the drag of a wing at near sonic speeds, and the merit of the particular combination of these factors in the crescent wing has been explained in some notes, with the above diagrams, prepared by Mr. R. S. Stafford, chief designer of Handley Page, Ltd. At the head of these notes appears this quotation from Omar Khayyam : " So while the Vessels one by one were speaking, one spied the little Crescent all were seeking."

The notes explain that high subsonic speed with low drag is attainable with wings that are straight-swept either backwards or forward or with razor-thin unswept wings. There are, however, serious shortcomings with straight-swept wings in that large sweep-angle cannot be used except at very low aspect ratio owing to poor stalling qualities. The back-swept crescent wing, where the angle of sweep progressively decreases towards the tip, permits the use of high aspect ratio for good altitude performance with good stall behaviour. On page 56 we show a characteristic crescent form with three variations of sweep. Wing thickness and sweep are proportioned so that the critical Mach number is the same at any point along the span.

To avoid compressibility effects a straight, unswept wing must be very thin indeed. It could be built in this way, the notes continue, but the bomber would look like a Christmas tree with engines and fuel tanks hanging from the wing and the undercarriage, like a child's scooter, taking up useful space in the fuselage. Such a design would be impossibly heavy and out of the running as a long-range bomber. As the figures show, practicable wing thickness at a high Mach number can be employed if combined with sweep.

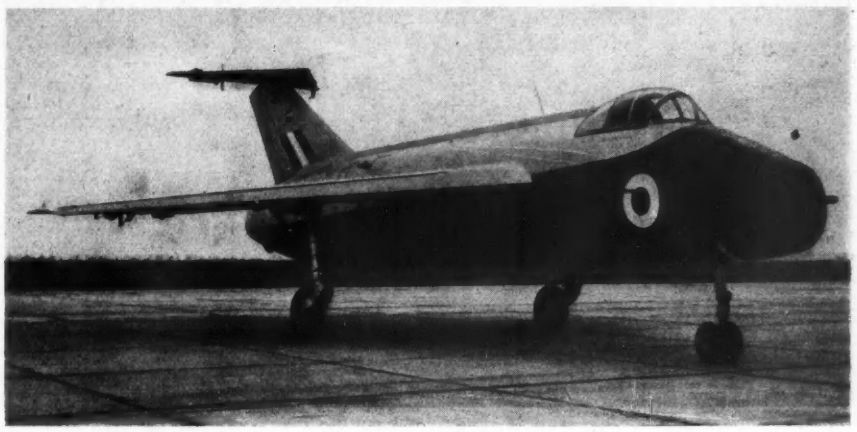
Air flowing over straight-swept wings is deflected outwards and if the wing has a high aspect ratio, this air builds up at the tip when the wing is near the stalling point. The tip stalls and the aircraft becomes unstable. The crescent wing, Mr. Stafford maintains, with its tip only slightly swept, avoids these handicaps.

The objections to the straight-swept wing of high aspect ratio are reinforced by bad aero-elastic qualities; here again, the " crescent " wing having a tip only slightly swept, the aero-elastic troubles are greatly reduced.

Unlike the " crescent," the swept wing of low aspect ratio suffers from having a poor performance at high altitudes, the induced drag being high. If the aeroplane is to operate at great heights, span (and hence wing area) must be large with corresponding penalties in drag and weight. Engine tail-cipes must be long and inefficient. The centre of gravity can only be moved between narrow limits. In order to take-off or land at a reasonable speed, the pilot must fly at an unusual angle, greatest lift being obtained only at high angles of attack. The notes then continue by stating that with crescent wing engines, fuel and undercarriage are enclosed in a light, efficient structure.

Its large centre-wing sweep enables a fuselage bomb-bay to be unobstructed as the main load-bearing wing structure is well forward. Behind this undercarriage wheels can be folded away and engines can be buried. They are accessible without weight penalty as no cut-outs are needed in primary members. It is pointed out that with the main structure ahead of the fire zone, the chance is remote of an engine fire being fatal.

(*To be continued*)



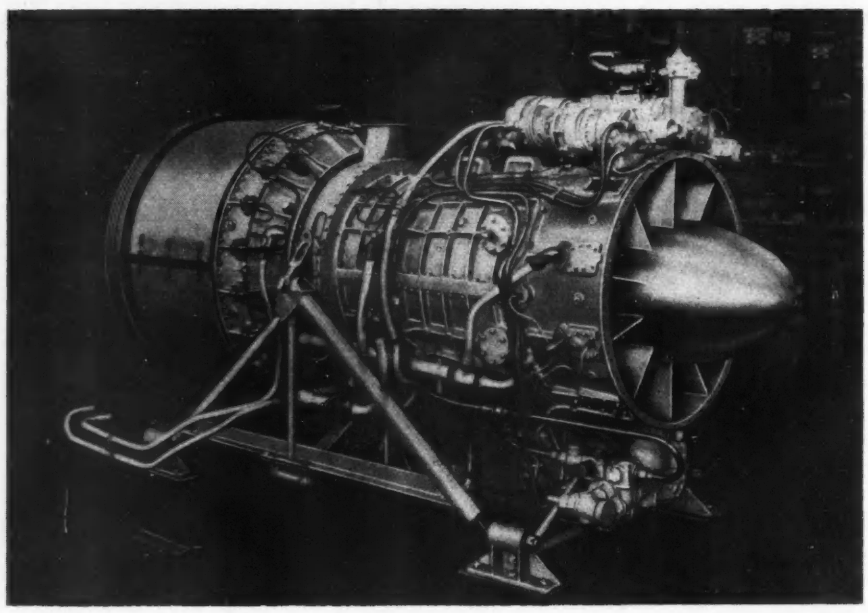
The " SB/5 " Adjustable Wing Research Aircraft

The Gloster " Javelin "

NATIONAL DIPLOMA IN AGRICULTURAL ENGINEERING.—At a recent open meeting of the Institution of British Agricultural Engineers, the president, Mr. F. E. Rowland, M.I.E.E., presented diplomas to six of the ten candidates who were successful in the 1952 examination for the National Diploma in Agricultural Engineering. The 1953 examination for the diploma will be held on July 21st. Forms of application can be obtained from the Institution at 24, Portland Place, London, W.1.

"G.2" Naval Gas Turbine

IN 1947 the "Gatric" gas turbine, which was designed and built by Metropolitan-Vickers Electrical Company, Ltd., was installed in M.T.B. 2009 of the Royal Navy as a boost power unit. The engine, rated at 2500 s.h.p., was of open cycle design without heat exchanger and consisted of a gas generator, based upon the "F.2" jet engine, and a separate power turbine. Sea trials with the unit proved successful and the Admiralty placed an order with the company for the development of four larger gas turbines, employing the same cycle as the "Gatric" engine, but giving improved performance. Known as the "G.2," the engines, as mentioned in our issue of December 26, 1952, have completed shore trials and have been installed in two motor torpedo boats, the "Bold Pathfinder" and "Bold Pioneer" for sea trials.



Gas Generator

The unit was designed to develop 4800 s.h.p., but the maximum power has been declared at 4500 s.h.p., with a maximum continuous rating of 4000 s.h.p. for the purposes of preliminary operational experience at sea. As for the earlier installation, the gas turbines will be used at high speeds and have a total life of 1000 hours, of which 300 hours may be run at maximum power. The complete unit consists of a gas generator, power turbine with exhaust duct and a reduction gear. A compressor, combustion chamber, compressor turbine and auxiliaries form the "G.2" gas generator, which is that of the "Beryl" jet engine modified, and the power turbine, mechanically independent of the gas generator, drives the propeller shaft through a single helical, side pinion reduction gear. The following figures compare the "Gatric" and "G.2" engines and serve to illustrate the improvement in performance.

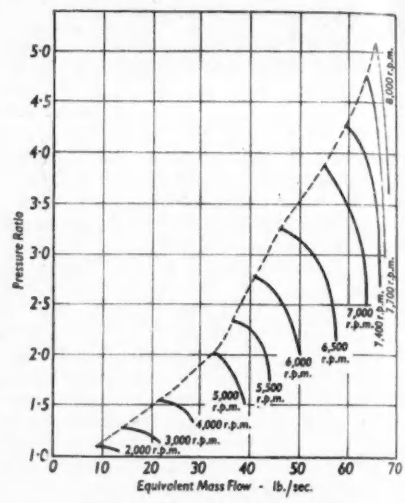
	"Gatric"	"G.2"
Rating, s.h.p.	2500	4500
Weight :		
Turbine unit, lb	4350	6949
Gears, lb	2600	2772
Complete unit, lb	6950	9721
Power/weight ratio, lb/s.h.p.:		
Turbine unit	1·74	1·54
Complete unit	2·78	2·16

Description

As shown in our photograph, the gas generator is supported at each side of the compressor by a built-up frame, bolted to the engine bearers, and pivoted so that they can swing outwards to allow for radial expansion. A small frame, pivoted to permit axial expansion, supports the forward end of the compressor and a sliding key under the compressor outlet maintains alignment of the unit. The compressor, which has eleven axial flow stages giving an overall pressure ratio of 4·03 at an air-mass flow of 62·6 lb per second for a maximum speed of 7830 r.p.m., has aluminium alloy moving and fixed blades and a casing of the same material. The longitudinal serrated grooves in the rotor carry the moving blades and the fixed blades are fitted into dovetail grooves in the casing. The rotor, which is carried by one ball and one roller oil mist lubricated bearings, consists of an inlet-end piece of manganese-molybdenum steel, a drum front extension, a drum centre and drum conical extension pieces of aluminium alloy, and a turbine end shaft of nickel-chrome-molybdenum steel. Provision is made for the removal of salt deposits from the blading and the general characteristics of the compressor are shown in the diagram reproduced herewith.

Finely atomised fuel is injected upstream through twenty fixed orifices into the primary chamber and the annular combustion chamber, which is of Firth-Vickers "Immaculate 5" stainless steel with fixing rings of F.C.B. (T) austenitic steel, is designed to give a straight-through axial flow. The single-stage gas generator turbine has a disc of molybdenum-vanadium steel mounted on a steel shaft attached to the compressor drum conical extension piece and the moving blades, of Nimonic 80.A. alloy, are secured by fir-tree fastenings. The fixed blades are of Nimonic 80 alloy. Air tapped from the compressor cools the turbine disc and the maximum inlet gas temperature to the nozzle guide vanes of the turbine is 806 deg. Cent.

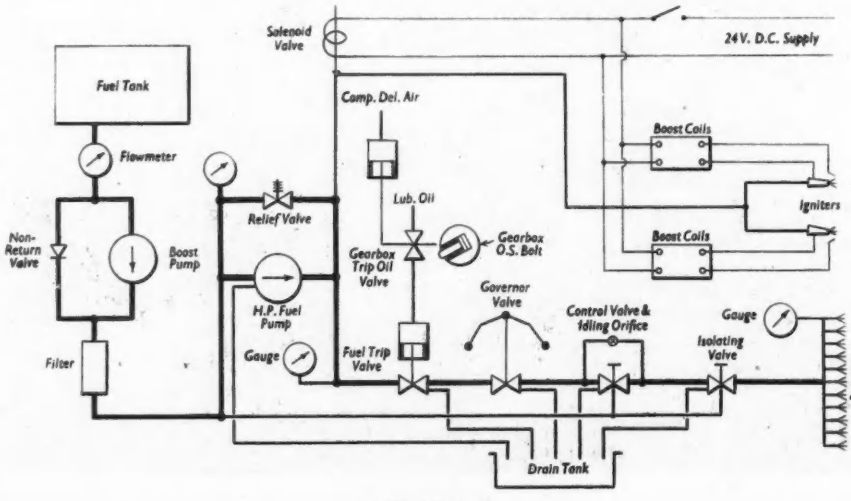
Two semi-flexible legs, mounted on a cross beam bolted to the engine bearers, carry the forward end of the power turbine, which is supported at the aft end from the gearbox. Three



Characteristics of the Compressor

Firth-Vickers F.C.B. (T) austenitic steel forgings welded together form the rotor, which is carried by one ball bearing and one roller bearing, both lubricated by an oil mist. The fixed diaphragm blades are of molybdenum-vanadium steel and the moving blades, secured by fir-tree fastenings to the discs, are of Firth-Vickers F.C.B. (T) austenitic steel, which is also used for the turbine casing. The maximum design speed of the power turbine is 5200 r.p.m. and the mean gas temperature at the inlet is 660 deg. Cent., which is 20 deg. Cent. higher than that calculated from fuel flow, due to stratification of temperature across the annulus. Lagging enclosed by sheet aluminium covers the engine from the forward end of the combustion chamber to the aft end of the exhaust, and the ejector effect of the turbine exhaust not only draws air into the aluminium casing to maintain it at a moderate temperature, but serves to remove fumes from the engine room.

The side pinion single reduction gear has a welded lightweight steel casing, incorporating a Michell thrust block, and a gear ratio of 4·73 to 1



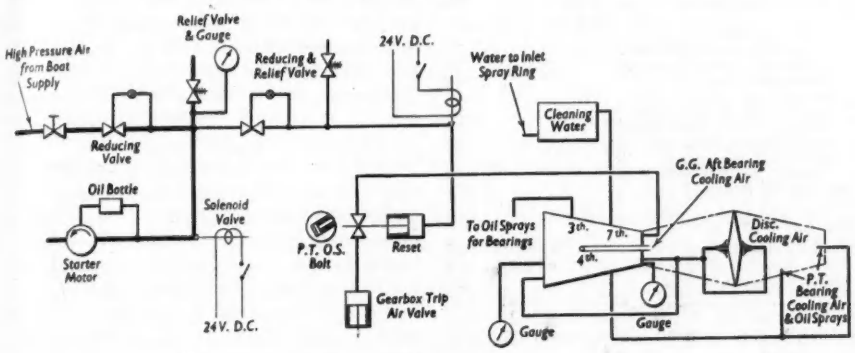
Fuel System

to give a maximum propeller speed of 1100 r.p.m. Both gear wheel and pinion are machined from nickel-chrome alloy steel forgings and carried in roller bearings.

Operational Systems

Direct regulation of the fuel supply controls the power output, and we reproduce on page 58 a diagrammatic arrangement of the fuel system, which includes a high-pressure fuel pump, driven from the gas generator rotor, capable of delivering 630 gallons per hour at 600 lb per square inch gauge at a pump speed of 3620 r.p.m. The gas generator is started by an air motor, and for stages for many purposes, including oil mist lubrication and cooling of the gas generator and power turbine bearings, cooling of the gas generator turbine disc, forcing the distilled water for blade cleaning from storage tank to compressor spray ring, operating the gearbox overspeed trip mechanism, and balancing the compressor thrust.

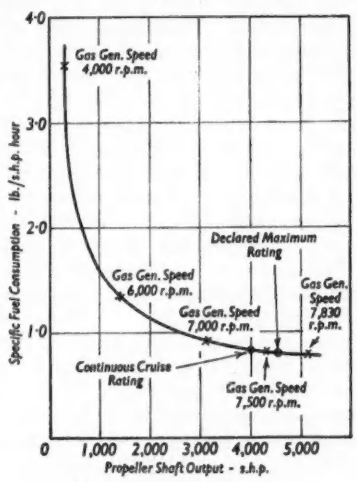
Lubricating oil is circulated from gearbox sump to gear teeth and thrust block by an auxiliary electrically driven pump when starting up, but upon the propeller shaft attaining a speed of 350 r.p.m the main pump, driven from the turbine shaft, takes over and supplies



Air System

speeds greater than the idling speed of 3000 r.p.m. the fuel supply is regulated by the main control valve. This consists essentially of a servo-operated calibrated needle, the movement of which allows sufficient oil to the burners, through a trip valve, overspeed governor valve and isolating valve to give a high rate of acceleration without stalling the compressor.

A ported sleeve centrifugal governor prevents overspeeding of the gas generator, while the relationship between power input and that absorbed by the propeller controls the speed of the power turbine. This is prevented from rising



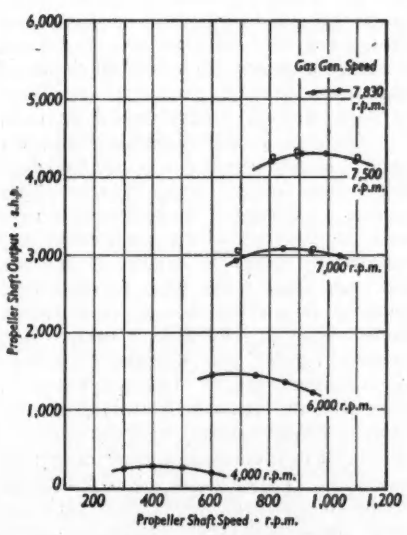
Fuel Consumption Curve

above a predetermined speed by two emergency trip governors, one on the turbine shaft and the other on the gearbox pinion shaft, which will close the fuel trip valve and the tripping mechanism is reset by an electrically controlled air piston operated by air at 100 lb per square inch gauge.

Storage bottles supply air at 450 lb per square inch gauge, by way of a reducing valve, to a light-weight compressed air motor for starting the gas generator, which becomes self-supporting at 2000 r.p.m. After ignition, acceleration to 2000 r.p.m. takes about thirty seconds, and to raise the speed to the idling speed of 3000 r.p.m. fuel is passed by boost and high-pressure fuel pumps through a fixed orifice by-passing the main control valve. Our diagram of the air system, reproduced on this page, shows that air is tapped from the gas generator compressor at various

oil from the oil tank to the gearbox. A scavenge pump returns the oil to the tank through a cooler. A pump, driven through reduction gearing from the gas generator shaft, supplies oil to the gas generator and power turbine bearings, which are lubricated by spraying with an oil mist formed of oil, which is not recovered, and compressed air. During cruising periods the unit is shut down and oil is supplied by an auxiliary pump, driven from the turbine shaft, to the bearings of the power turbine, which is rotated by the trailing of the propeller, while an electric inching motor turns the compressor rotor of the gas generator.

The electrical system is in three sections, namely, 24V d.c. and 220V d.c. circuits and instrument circuits. Operating on 24V circuits are three solenoid valves controlling the fuel supply to the igniters, the air supply to the power turbine emergency governor reset piston and to the starting motor. Two ignition boost coils supply high-tension current to the spark plugs for igniting the two torch igniters. The 220V circuits control the inching motor and auxiliary lubricating oil pumps. In both circuits suppressors are fitted to prevent interference by the boost coils and the inching motor. Limit switches, mechanically connected to the fuel control and isolating valves, are interlocked electrically with the solenoid valve for the starting



Propeller Shaft Output

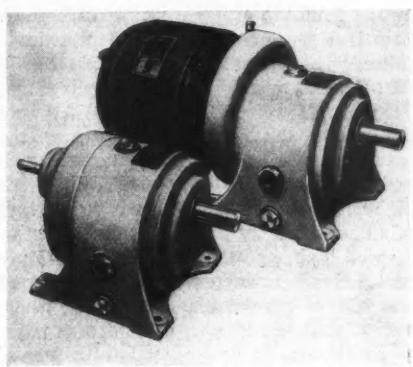
motor and with the inching motor and its contactor. This arrangement ensures that the starter motor solenoid valve cannot be energised if the fuel valve is open and also that the inching motor cannot be started when either the starting motor solenoid is energised or the fuel isolating valve is open.

The performance figures obtained from a series of extensive bench tests are given graphically in two accompanying diagrams, in which fuel consumption is plotted to a base of propeller shaft output and propeller shaft output is plotted to a base of propeller shaft speed.

Geared Electric Motors

An addition has recently been made to the range of "Coventry" geared motors made by the Coventry Gear Company, Foleshill, Coventry, a member of the David Brown Group of companies. This unit is designated "Size 3" and is available in either double or triple reduction form. With a motor speed of 1425 r.p.m. a choice of seventeen output speeds ranging from 25 r.p.m. to 345 r.p.m. is available, the equivalent variation of input powers being from 1·25 h.p. to 5 h.p.

The motors can be mounted in any of several positions and lubrication, oil level inspection, draining and refilling can be carried out without difficulty in any of the mounting positions. Since their total height is very little greater than that of the motors alone, the geared units are particularly suitable for installation in confined spaces. The



Gear Reduction Unit and Geared Motor

weight (excluding motor) of the double reduction unit is 105 lb. and of the triple reduction version 110 lb.

Any type of motor up to 14in diameter may be fitted to suit individual requirements; alternatively the gear units are available without motors, as shown on the left of our illustration. In such cases the motor adaptors are replaced by modified covers, and the input and output shafts are coaxial.

All gears in the unit are precision cut and of high-tensile steel. The first reduction is by single helical gears, while second and third reductions are by spur gears. The maximum load which can be accommodated on the output shaft is equivalent to a steady tangential load of 800 lb at a radius of 1in when applied midway along the shaft extensions.

The case is a one-piece iron casting, faced at each end to receive the end cover, motor adaptor and gear assembly, and incorporates a combined filling and ventilating plug, drain plug and oil level indicator. The end cover and adaptor have oiltight and dustproof joints, and an oil seal is provided in the output shaft cover.

The gears are splash lubricated and the internal arrangement ensures an adequate flow of oil to each bearing. When vertical mounting of the unit is specified a screw pump is incorporated to provide a positive oil feed to the top bearing and gears.

The overall efficiency of the geared motor is approximately 96 per cent (double reduction unit form) and between 94 and 95 per cent (triple reduction unit).

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ILL-PLACED ROAD SAFETY PROPAGANDA

Road accident statistics are published in a new form in " Road Accidents, 1951," issued by the Ministry of Transport last Tuesday. Part I, a general survey, which precedes a collection of very valuable analytical tables in Part II, seeks to stress in simple language that 5250 people were killed and 211,243 were injured on the roads in 1951, how the casualties were spread amongst road users and how accidents were divided amongst different classes of vehicles, that 76 per cent of all accidents occurred on roads subject to a speed limit, and that not less than 43 per cent of all accidents occurred at road junctions or cross roads. The tables, which follow, analyse accidents in numerous ways, by months, by the ages of victims, by type of road, by time of day, and so forth; and another set analyses them according to kinds and movements of vehicles and actions of pedestrians involved and by the characteristics of the road at the place concerned. All these tables have the virtue of being purely factual. There cannot, for example, be any doubt of the sad fact that 3354 child pedestrians " crossing road masked by stationary vehicle " were injured or killed by vehicles " going ahead (and overtaking or passing)." The same cannot, however, be said of the final group of tables in the publication. These tables analyse " factors " which were " regarded by the police as contributing to the accident." They are not factual; and in our opinion the conclusions reached should be regarded with great reserve. For how many policemen, especially amongst those who have never driven a vehicle, have the experience on which to base a sound opinion whether, for example, " proceeding at excessive speed having regard to the conditions " or " overtaking improperly " or even " turning right (or left) without due care " were factors contributing to an accident? Moreover, even if the opinion is soundly based, it is almost always true that a number of factors combine to bring an accident about. To single out one of them—and that the one which lays the blame almost always on the road user to the exclusion of other factors, such as road defects—is far from satisfactory.

The publication of road accident statistics ought, surely, to be as wholly factual as possible. But the Ministry in issuing these statistics has attempted to make them a part of the Ministerial propaganda for more safety on the roads. In the result it seems to us that a false impression is given. For example, in a short introduction to the publication the Minister of Transport remarks of the public: " It is to them as road users and not to rules, regulations or mechanical devices that we must look for an early reduction in the number of accidents." Though we agree that safety is not satisfactorily to be sought by the imposition of yet further rules and regulations upon road users, it is very far from the truth to suggest that improved mechanical devices on vehicles and the further use of traffic lights and other devices on the roads cannot contribute to safety. Moreover, the Minister's statement wholly omits mention of the very effective, if costly, remedy for road accidents that lies in improvement of the roads. It is true that some small mention is made, in Part I, preceding the tabular matter, of the contribution that could be made by road improvement. But the statement which follows, " A solution is possible only if all classes of road users can be trained to a higher standard of road conduct based on care, courtesy and intelligent consideration for others," is only true if it is hoped to reduce the number of accidents to zero. For without any change in the behaviour of road users, improvement of the roads could very substantially reduce the number of accidents that occur upon them. Nor do we believe that any very substantial improvement in the behaviour of road users is likely. For, however careful and considerate human beings normally are, all of them fail at times to act up to the highest standards, all of them make occasional mistakes and misjudgments, and out of their common human frailty they always will. The only sure way to reduce the number of accidents upon the roads is to accept the fact of human frailty and so to improve the roads that the openings for human beings to make mistakes and misjudgments are reduced in number and the consequences of making them become less serious. That is the course that has been pursued continuously by the railways in the installation of all kinds of devices to ensure that the failure or misjudgment of a railway servant will not lead to a fatal accident, and it has brought about a truly astonishing standard of safety for the traveller in trains.

In three places the report refers to the work of the Road Research Laboratory. But it fails to bring out what are the lines of investigation that Laboratory is following. It is not trying, as is the Ministry, to make road users change their road behaviour to suit roads unfitted for modern traffic. It is, instead, studying, successfully, how road users do, in fact, behave upon the roads, so that roads and vehicles can be designed to suit that behaviour. Zebra pedestrian crossings have proved a success because their design is based upon scientific observation of the way road users behave at crossings, not upon a moral assessment of how they ought to behave. Scientific study has shown that the fitting of two rear lights similar to those fitted to most modern cars makes vehicles far more visible and the assessment of their distance easier for human beings in the dark, a very big contribution to safety if it is followed up, as it should be, by legislation. Traffic studies, based upon observation of what drivers and pedestrians do, not what they ought to do, are providing information upon which improvements to existing streets and designs for new ones can be soundly based. Studies of road layout, of the qualities of road pavements, lighting, &c., are all contributing to making the roads safer. What is holding down standards of safety upon the roads, now, is far less the careless and inconsiderate behaviour of road users, the majority of whom (even amongst those who suffer accidents) normally behave well, but the Governmental conviction that the nation cannot afford to expend money at present on the improvement of the roads. But surely what can be afforded is a matter of outlook and habit. If the nation really wants to reduce road accidents quickly it can find the means to " afford " to do so, by improving the roads. It is therefore regrettable that a factual document like " Road Accidents, 1951," purporting to give an unbiased statistical summary of accidents on the roads should have been used to preach the opposite and one-sided propaganda of the Ministry. In our opinion it would have been better to have restricted it to its statistical tables, accompanied by a purely factual summary of what the tables reveal. The Ministry's propaganda should appear in a separate publication.

THE VIRTUES OF VANDALS

The other day we came across a little note in one of the evening papers recording, if we recollect aright, a project for classifying part of Paddington station as a building of special architectural and historic interest on account of its association with Isambard Kingdom Brunel. There are parts of other London stations, too, surely as worthy of an honour that would mean that no structural alteration could be made without reference

to the local planning authority ! There are, for instance, the great hall of Euston Station, the arched roofs of St. Pancras and King's Cross, even, perhaps, as a curiosity, the St. Pancras Hotel. But what purpose would be served ? There are at least as many users of London's main line stations who would like to see them rebuilt, as there are those who would preserve them. For many of our London termini are inconvenient, and one of them, Liverpool Street, almost intolerably so. Nor, should we accept the views of many town planners, can they be considered well sited. Supposing that these stations are classified as of special architectural and historic interest, is the user of them to abandon hope, ever, of improvement ? And, should the town planners have their way and remove a terminus to some other site, what is to be done with a "classified" building unsuited for any other purpose than the ending of a railway ? The problem of its preservation would be far less soluble even than that very sad one of maintaining unnumbered great country houses that no one is now rich enough to live in ! Let us leave aside paintings, sculpture, ornaments, and the like. They have an æsthetic value, quite apart from any use they may have, and obviously should be preserved. But ought we to attempt the preservation of a structure, be it a railway station, a bridge or anything else, built primarily for a utilitarian purpose that it can no longer serve, nor any other either ?

It is said that if someone arriving late in a strange town in England asks a passer-by to direct him to the best hotel he will invariably be sent to the oldest ; whereas should the country be America his informant will direct him to the newest ! The comparison is, of course, apocryphal. Yet it undoubtedly illustrates a difference in national characteristics. For if the Americans are open to the criticism that they are far too willing to fling away the old and adopt the new, merely because it is new, the English (even if not the Scots, the Irish and the Welsh) often hang on to the old, long past its best, rather than welcome something, be it a process, a machine, or a structure that could better serve its purpose. What a hubbub, for instance, there was over the rebuilding of Waterloo Bridge, and what a to-do there is whenever an engineer proposes to build a dam, create a reservoir or put up a power station ! It is obvious enough that we are on the side of the innovators. Most engineers are. Even so, let it not be thought that we have no respect for the past, no realisation of the duty of the present to preserve objects from the past for the instruction of the future. But it does seem to us that there are plenty of societies in this country devoted to the preservation of this, that and the other. Though we greatly honour and would not be without the work done in preserving engineering antiquities by the Science Museum, the Newcomen Society, the Cornish Engines Preservation Society, and very many others we often wonder whether enough credit is allowed vandals who seem willing to pull anything down if only something new is to replace it ! At least it must be granted them as an implicit virtue that they seem to have a remarkable faith in the ability of the present generation to produce structures as beautiful as any built in the past. They have courage, too. Sometimes they may even be right ! What a loss the country suffered, antiquarians will exclaim, when the Great Fire destroyed London in the days of Charles II ! But could we ever have had fine new Wren churches and a noble new St. Paul's if that fire had not raged ? May not renewed destruction by fire in the last war provide the opportunity to widen streets originally too narrow for twentieth century traffic and to erect buildings better suited than the old for modern business ? Even vandals must have shuddered at that wholesale twentieth century destruction. But are we, who think ourselves more normal, quite sure, now that it has happened, that there is not relief admixed with our emotion, relief that we are rid of an ancient, impractical layout that threatened to become a burden ?

Nor in this discussion is it only the civil engineer who builds bridges, dams rivers, and erects great buildings who is involved. No owner of a factory, surely, should hesitate to pull down old factory buildings, even though some historic interest attaches to them, if he is convinced that they are no longer suited to modern purposes ! He will, indeed, be blessed if he finds the means to preserve only the least of them intact to form a works museum. Ought we not to carry the same mood into the operation of a factory ? There is even something to be said for trying a new design or a new process merely because it is new, and without a full demonstration of its value. The American who directs a visitor to the newest hotel in the town is unquestionably showing irrational confidence in the virtues of the new, since mere novelty is not a recommendation in itself. But at least, by enthusiastically adopting the new whenever it appears, he must sooner or later stumble upon something novel that really is valuable ; and that can never be said of the diehard conservative to whom oldest and best are synonymous terms ! Certainly we should not discard the old with the gay abandon with which a few days ago we flung off the Old Year and welcomed in the New. For much trouble and disappointment will be saved if we exercise careful judgment in deciding what to discard and what to retain. But when the old and historic stands squarely in the way of something we are convinced will be better suited to our modern purposes, when there is no convenient or reasonable way of allowing it to perform some modern function, then we should have the courage to destroy. We ought to have confidence in our ability to create something new æsthetically or technically as interesting and instructive to posterity as the thing destroyed, and much more useful !

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

A GAS TURBINE LOCOMOTIVE EXPERIENCE

SIR,—Mr. Kitchen's letter of December 15th prompts me to say that I agree with Mr. Livesay, and that locomotive running is recorded in detail far greater than is justifiable—or interesting.

Those who delight in meticulous records of time-keeping, speed, shovelsful of coal, drops of oil, &c., can have their fill in a popular, contemporary magazine devoted to railways. Such records are dreary, however, particularly so to readers not intimately acquainted with the routes covered. They may warrant publication in a popular journal produced for railway enthusiasts who even find lists of engine numbers and names of absorbing interest. They do not deserve valuable space in a technical journal and to many readers columns devoted to information(?) of this type are just a dead loss.

I have been privileged to obtain a limited amount of footplate experience and it was never dull. Mr. Livesay may have found it dull at times, during his extensive experience, and an occasional rest in the train was justifiable. His excellent articles are far from being dull—to the contrary, they have been instructive and entertaining. More power to his elbow and long may he record his interesting locomotive and travel experiences.

E. B. PARKER

Wirral, Cheshire,
January 2nd.

Splitter Column for Stanlow Refinery

A SPLITTER column has recently been delivered to the Stanlow Refinery of the Shell Petroleum Company, Ltd., from the Barnsley works of W. J. Fraser and Co., Ltd. The column, which is 106ft in height and 3ft 6in in diameter, is designed to separate ethane and ethylene to be used in the manufacture of chemicals. In order to separate these gases one of the components must be liquefied, to be removed from the bottom of the column, and the other will remain as a gas and leave at the top of the column. To liquefy the bottom component high pressure and a low temperature are required, and the column will operate at 360 lb per square inch pressure and 0 deg. Fah. at the top. Specially designed fractionating equipment has been fitted, to ensure clean separation between the components, and this includes "Turbogrid" distillation trays, designed by the Shell technicians, which are carefully spaced at various levels and have parallel slots of a specified width and spacing.

The steel used in the construction and its heat-treatment had to be selected with a view to the material having adequate resilience at the low operating temperature. In addition, the high pressures combined with low temperature called for careful inspection at all stages of manufacture, particularly the welded joints ; those at the lower part of the column were X-rayed, and for those at the top the ultrasonic method was adopted. This necessity of close inspection made it essential that no welding was carried out on site so that the base was welded on at the factory. Having an overall height of 118ft and weighing 45 tons, the completed unit was transported from the factory to the refinery by road.

BOOKS RECEIVED

Development of the Guided Missile. By Kenneth W. Gatland. London : Iliffe and Sons, Ltd., Books Department, Dorset House, Stamford Street, S.E.1. Price 10s. 6d.

Strain Gauges Theory and Application. By Prof. Dr. Ir. J. J. Koch and Ir. R. G. Boiten. London : Cleaver Hume Press, Ltd., 42a, South Audley Street, W.1. Price 15s.

National Smoke Abatement Society Year Book, 1952. London : National Smoke Abatement Society, Chandos House, Buckingham Gate, Westminster, S.W.1. Price 1s.

Elementary Heat Power. Second Edition. By H. L. Solberg, O. C. Cromer and A. R. Spalding. London : Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 52s.

Practical Mathematics. By Louis Toft and A. D. D. McKay. London : Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 30s.

Polarised Light in Metallography. By G. K. T. Conn and F. J. Bradshaw. London : Butterworths Scientific Publications, Bell Yard, Temple Bar, W.C.2. Price 21s.

Composite Catalog and Buyers' Directory. Seventeenth edition. U.S.A. : Telephone Engineer Publishing Corporation, 7720, Sheridan Road, Chicago, 26, Illinois.

Passenger Launch "Ikeja"

TWO 40ft passenger launches designed as ship-to-shore tenders have recently been delivered to the Elder Dempster Lines. The launches are the "Ikeja," which will operate at Lagos, and "Falaba," at Freetown. The latter arrived in Liverpool in October last and the former, seen in our photograph, was handed over to her owners last month after making the 250-mile voyage from Bideford.

Both of the aluminium alloy launches have been designed and built by Grimston Astor, Ltd., of Bideford, North Devon, to Ministry of Transport requirements, and the "Two-Way Tension" system of construction, in which the company specialises, has been employed. This system, which was described in THE ENGINEER of February 23, 1951, allows the shell of the boat to be prefabricated in the flat unstressed condition before being flexed upwards about the centre-line to form a predetermined shape. The resultant restrained double curvature gives a springy resilience to the shell by reason of the strain energy absorbed. There is a considerable saving in hull weight and this has a cumulative effect; less horsepower is required so that the size and cost of the motors are reduced, giving economies in both running and maintenance charges.

Passenger Launch "Ikeja"

The launches, which have been built of aluminium alloy supplied by the British Aluminium Company, Ltd., have a length of 40ft by 12ft beam by 2ft 9in draught and carry a total of sixteen passengers at 14 knots. No. 10 gauge aluminium alloy sheet to standard specification "N.S.5" in the quarter-hard condition, has been used for the shell, decks and transom, while the combined shaft bracket and skeg, the stern tube and the rudder have been cast in the heat-treated high tensile aluminium alloy to standard specification "L.M. 10 W." The necessary power is supplied by a Foden "F.D.6" marine diesel engine of 120 h.p. at 2000 r.p.m., having a continuous rating of 104 h.p. at 1800 r.p.m. and fitted with a heat exchanger, cooled exhaust manifold, and the necessary pumps and auxiliary equipment. Power is transmitted through a Mk. "M.R.10 B" direct drive gearbox, manufactured by the Self Changing Gear Company, Ltd., and a vee drive gear supplied by J. Samuel White and Co., Ltd., and 1¼in diameter stainless steel shafting to a three-bladed light alloy propeller.

By adopting the vee drive arrangement it has been possible to install all the machinery in a compartment right aft and by placing the spacious engine-room in the stern of the boat unobstructed access to the rest of the launch is obtained. Forward of the machinery space is a water-tight and gas-tight compartment fitted with the fuel and water tanks and above this space is a landing deck which leads to a saloon containing seating accommodation and spaces partitioned off for the helmsman and the baggage. Continuing forward, steps lead down from the saloon to a roomy cabin having seats for eight passengers and an escape hatch in the roof. In the fore deck is a water-tight hatch which provides access to a storage compartment, separated by water-tight bulkheads from the main cabin, which is immediately aft, and from the fore peak and chain locker, which is further forward. The bulkheads have been so arranged that should any one compartment be damaged the launch will not sink. The equipment includes a raft for sixteen persons and the fire appliances and pumps required for the Ministry of Transport Steam 5 Certificate. From the results of the inclining experiment the launch was shown to have a metacentric height of 3·43ft in the fully loaded condition in which the displacement amounted to 6 tons, and a further calculation indicated that with two-thirds of the passengers on one side of the launch and one-third on the other the angle of heel would be only slightly more than 2 deg.

B.E.A. Generating Plant Construction in 1952

THE British Electricity Authority states that new generating plant installed during 1952 yielded an additional output capacity of 1539MW, compared with 1951, when 1113MW of plant were installed.

The additional plant, comprising thirty-four turbo-alternators with an aggregate installed capacity of 1550MW and fifty-nine boilers having an aggregate evaporative capacity of 16,985,000 lb per hour, was installed in thirty-two of the Authority's power stations, including seven new stations in which plant has been installed for the first time. Details are given in the accompanying table.

The Authority's maximum planned rate of commissioning for 1951 was 1250MW, and for 1952, 1400MW, making a total for the two years of 2650MW. The actual plant installed in the two years aggregates 2652MW. The past year's achievement has therefore brought the performance in the last two years up to the maximum rates planned.

To meet the winter peak demand the Authority aims, each year to commission the maximum amount of plant by December 31st, and as a result of strenuous efforts by the Authority's construction staff and the manufacturers some of the plant has been installed in advance of its expected date of completion.

The maximum planned rate of commissioning for 1953 is 1500MW, but because of shortages of steel and other materials, which have been particularly acute during the last eighteen months, the B.E.A. anticipates that there may be difficulty in achieving the target.

Generating Plant Commissioned by the British Electricity Authority in 1952

Name of power station	B.E.A. Divisions	Turbo-generator plant		Boiler plant		Main high-pressure pipework
		Installed capacity in kilowatts	Maker	Capacity in lb/hr	Maker	Maker
*Bankside	London	1×60,000	British Thomson-Houston	2×375,000	Foster-Wheeler	C. A. Parsons
*Barking "C"	London	1×75,000	British Thomson-Houston	—	—	Aiton
Battersea "B"	London	—	—	2×425,000	Babcock and Wilcox	Aiton
Blackburn	North Western	1×40,000	English Electric	3×150,000	Simon-Carves	Babcock and Wilcox
Blackwall Point	London	1×30,000	English Electric	1×365,000	Babcock and Wilcox	Babcock and Wilcox
Braehead	South West Scotland	1×50,000	C. A. Parsons	2×300,000	Babcock and Wilcox	Babcock and Wilcox
*Brighton "B"	South Eastern	1×52,500	Richardsons, Westgarth	2×320,000	Babcock and Wilcox	C. A. Parsons
Bromborough	Merseyside and North Wales	2×50,000	English Electric	2×300,000	Babcock and Wilcox	Stewarts and Lloyds
*Brunswick Wharf	London	2×52,500	Metropolitan-Vickers	4×320,000	Clarke Chapman	C. A. Parsons
Clarence Dock	Merseyside and North Wales	—	—	2×350,000	Babcock and Wilcox	Stewarts and Lloyds
Cliff Quay	Eastern	1×45,000	Metropolitan-Vickers	—	—	Aiton
Croydon "B"	South Eastern	—	—	2×320,000	Simon-Carves	Aiton
Deptford East	London	—	—	1×250,000	Foster-Wheeler	John Thompson
*Huncoat	North Western	2×30,000	General Electric Company	2×305,000	Simon-Carves	C. A. Parsons
Keadby	Yorkshire	2×60,000	C. A. Parsons	1×550,000	Stirling Boiler Company	C. A. Parsons
*Littlebrook "C"	South Eastern	1×60,000	C. A. Parsons	2×360,000	International Combustion	C. A. Parsons
Nechells "B"	Midlands	1×52,500	C. A. Parsons	3×230,000	International Combustion	Stewarts and Lloyds
Northampton	East Midlands	1×30,000	C. A. Parsons	2×190,000	Simon-Carves	Stewarts and Lloyds
North Tees "C"	North Eastern	2×60,000	C. A. Parsons	2×360,000	Babcock and Wilcox	Babcock and Wilcox
Plymouth "B"	South Western	2×31,500	Metropolitan-Vickers	2×320,000	Yarrow	Babcock and Wilcox
Poole	Southern	1×50,000	C. A. Parsons	2×300,000	International Combustion	Aiton
Portsmouth	Southern	1×30,000	British Thomson-Houston	2×180,000	Mitchell	C. A. Parsons
Rotherham	Yorkshire	—	—	1×200,000	International Combustion	Stewarts and Lloyds
Rye House	Eastern	1×32,000	Richardsons, Westgarth/C. A. Parsons	1×350,000	Babcock and Wilcox	Stewarts and Lloyds
Skelton Grange	Yorkshire	1×60,000	C. A. Parsons	2×360,000	International Combustion	Aiton
Staythorpe	East Midlands	1×60,000	British Thomson-Houston	3×240,000	Babcock and Wilcox	Aiton
Thornhill	Yorkshire	1×45,000	English Electric	1×180,000	Mitchell	Stewarts and Lloyds
*Uskmouth	South Wales	1×60,000	General Electric Company	2×360,000	Babcock and Wilcox	Aiton
Warrington	Merseyside and North Wales	1×30,000	Brush Electrical	1×200,000	Simon-Carves	C. A. Parsons
West Ham "B"	London	2×30,000	English Electric	3×180,000	John Thompson	Aiton
Westwood	North Western	1×30,000	British Thomson-Houston	2×300,000	Babcock and Wilcox	Stewarts and Lloyds
Woolwich	London	1×30,000	General Electric Company	2×180,000	John Thompson	C. A. Parsons

* New stations

Electrical Engineering in 1952

No. II—(*Continued from page 28, January 2nd*)

Grid System Operation

As stated in the fourth report of the B.E.A., operating conditions on the grid system continued to be difficult because of the shortage of generating plant and transmission facilities for interconnection. It was forecast that the maximum demand in 1951–52 would exceed that in 1950–51 by about 900MW under similar weather conditions and severe load-shedding was, therefore, anticipated. As it happened, however, the plant/load factor was better than expected. Indeed, from October to March there were only six occasions when consumers had to be disconnected, compared with eighty-six in the corresponding period of 1950–51.

One of the reasons for the improvement in the plant/load ratio was that the B.E.A. completed its main annual programme of plant overhaul earlier than usual; during the winter the plant capacity out of commission for overhaul was about 350MW less in 1951–52 than in the previous year. Another reason was that the growth of demand was, in fact, some 300MW less than was forecast, mainly because of the change-over to armaments manufacture and the recession in the textile industry.

One of the difficulties experienced in mainly industrial districts during the summer months was that of low voltages, resulting from shortage of generating plant and the consequent inability to generate, locally, the local reactive kVA demand. As mentioned in the B.E.A. report for 1950–51, this difficulty has led to local load-shedding at some grid supply points and occasionally has prevented a reduction in system voltage which would have allowed the peak demand to be met without disconnection of supplies. To give temporary relief the B.E.A. decided to use the alternators of generating sets which would be out of commission in the summer for turbine repairs, and to convert such alternators for use as synchronous condensers.

Accordingly, in 1951, two alternators, one of 30MW at Ocker Hill power station, Tipton, and one of 15MW at Dunston power station, were uncoupled from their turbines and modified to run on the supply system as synchronous condensers. Operating conditions were thereby greatly improved during the critical summer period. Load-shedding because of voltage difficulties was completely eliminated in the Newcastle grid control area and the eastern ring of the Leeds grid control area. A substantial improvement in voltage conditions was also obtained in the Birmingham grid control area and, to a lesser extent in the South Wales section of the Bristol grid control area. At the end of the summer, when the turbine repairs had been completed, both alternators were remodified and reverted to their normal function of generating electricity.

Thermal Efficiency

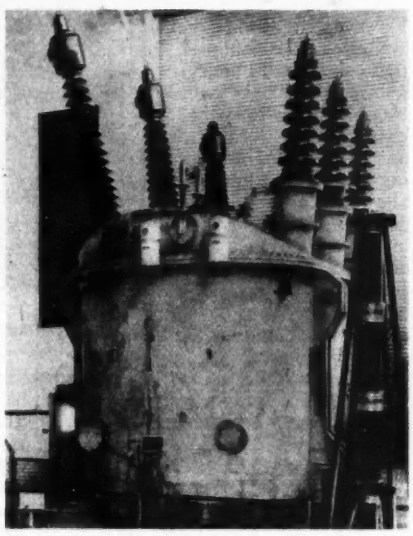
Continued improvement in the overall thermal efficiency of generation is reflected in the figures tabulated herewith.

Year ended March 31st	Overall average thermal efficiency (sent out) per cent
1948	20·86
1949	21·15
1950	21·33
1951	21·54
1952	22·04

It is interesting to reflect, as suggested by the B.E.A. annual report for 1951–52, that the improvement in thermal efficiency depends on the rate of installation of new, more efficient plant, and on the rate of growth of demand. In recent years shortage of plant has necessitated the retention and increased loading of plant of relatively low efficiency, which adversely affects the overall figure. During the second half of 1951–52, however, there was a decline in the rate of growth of demand, which allowed less efficient plant to be taken off load, and contributed towards the noteworthy improvement from 21·54 per cent in 1951 to 22·04 in 1952.

Cascade Tripping

The urgent need for adequate transmission line capacity in the grid system as it is operated to-day is emphasised by an account given in the current B.E.A. annual report of a serious supply interruption caused by "cascade tripping" on September 3, 1951. Although this date falls outside the period under review, the sequence of events is described here to illustrate the kind of operating conditions that make it necessary,



120MVA, 275/132kV Auto Transformer for B.E.A.

as a matter of urgency, to reinforce the 132kV grid and to superimpose the new 275kV grid.

It should be explained that, to maintain security of supply, the Grid transmission circuits must be loaded in such a way that, if one circuit is automatically disconnected by a fault, none of the others can become loaded above the maximum safe capacity. If this value should be exceeded the circuit is switched out by automatic protective devices. This switching may cause the disconnection of other circuits. Such a sequence of events is called "cascade tripping" and may cause widespread dislocation of supplies. Under conditions of rapidly changing demand it is possible, despite constant vigilance, that circuit loadings may, for short periods, reach values sufficient to cause cascade tripping.

Such conditions occurred at 4.57 p.m. on Monday, September 3, 1951, when the three circuits feeding the Merseyside and North Wales Division and the western section of the North Western Division and one circuit linking the S.E. Scotland Division and the North Eastern Division, tripped in cascade because of an unexpected increase of load. There followed widespread interruption to supplies to the Merseyside and North Wales and North Western Electricity Boards.

As explained in the B.E.A. report, a shortage of generating capacity in the western section of the Manchester grid control area had aroused concern for some weeks before the breakdown and, on the day concerned, a 50MW set at Clarence Dock power station, Liverpool, had to be taken out of service for urgent maintenance because, through a manual workers' ban on overtime no maintenance was possible at night or week-ends.

In the morning of September 3rd load and plant estimates indicated that it would be necessary to import about 100MW into the affected area at the time of the late afternoon peak load. In fact, however, 144MW was imported at 4.43 p.m. It was appreciated that the occurence of a fault might cause cascade tripping because the imported power was not shared equally by the three incoming circuits. But this possibility was accepted as a reasonable hazard, because it was expected that the load would start dropping before 5 p.m. Nevertheless, efforts were made to improve the load distribution on the circuits.

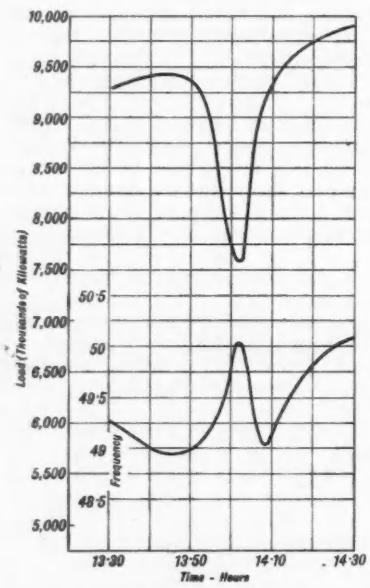
At 4.57 p.m. four circuits were disconnected by cascade tripping and, as a result, the rest of the grid system was isolated from Scotland and most of the Merseyside and North Wales Division and the western section of the North Western Division. Sufficient generating plant was running in Scotland to make her self-supporting and permit reconnection to the rest of the system at 5.47 p.m. But the other affected areas were left with a demand nearly 40 per cent greater than the generating capacity available locally. There was a rapid fall in frequency and voltage and power stations in the area shed load in an effort to halt the fall in frequency. The attempt failed and most of the generating plant had to be taken off load, either because of alternator instability or because auxiliary plant failed to operate adequately at the low frequency. Each power station was disconnected from the grid as its plant was shut down. Local restoration of load was then started as soon as generation could be resumed locally. At 5.39 p.m. the isolated section of the grid was made alive from the main system. Restoration of load continued and the process was completed at the power stations by 8.06 p.m., but it was not until 9.30 p.m. that all supplies had been restored in the Area Board distribution system at Liverpool.

Abnormal Operation of Grid System

From the foregoing account it will be clear that conditions likely to cause cascade tripping can arise at times of sudden and unforeseeable changes in demand over, possibly, quite short periods. On the other hand, equally large and rapid changes of load, provided their incidence can be estimated with some confidence, can, usually, be provided for by the system operations engineers. An interesting example, which was quoted in our issue of April 4, 1952 (page 479), relates to the very rapid fluctuation in load that accompanied the two minutes' silence marking the funeral of the late King George VI at 2 p.m. on Friday, February 15, 1952. The curves on page 64 show the load variations and the corresponding changes in the supply frequency on that occasion. The load curve is based on frequent spot readings without making any allowance for departures from normal frequency or for any consequent changes in system voltage. Although the time of the load change associated with the two minutes could be anticipated there was no means of arriving at a reasonable estimate

of the actual change in demand ; the consequent frequency variations were therefore unpredictable.

To prevent the frequency from reaching a dangerously high level because of the sudden fall in load, the value of the frequency was deliberately reduced, beforehand, to about

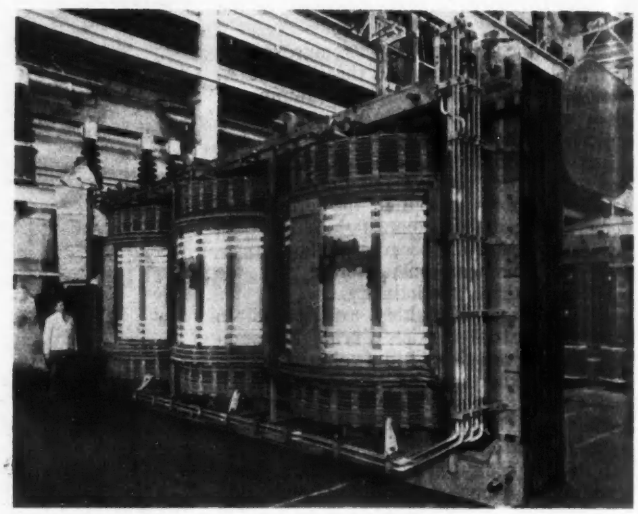


National Load and Frequency Curves for 13.30 to 14.30 hrs on Feb. 15, 1952

49 c/s. Subsequently, as the two-minute period approached the rate of change of frequency became abnormally high and, at times, exceeded 0·25 c/s per minute. For the five minutes immediately after the silence the average rate or rise in demand was more than 330MW per minute, or 7000 h.p. per second.

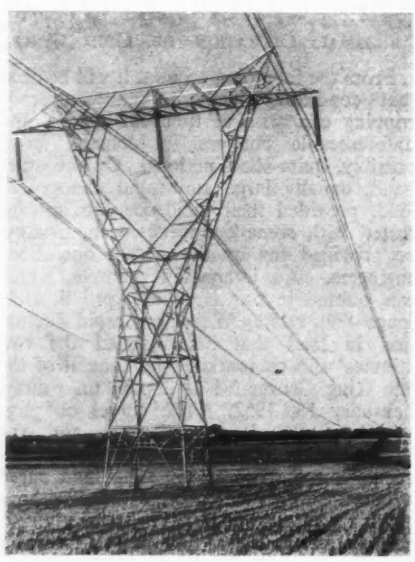
In anticipation of the loading conditions to be expected during the period affected by the silence a full programme of operations was drawn up for all the generating stations in the national supply system. For example, many of the smaller stations were given programmes for decreasing over a ten-minute period before the silence and a programme for increasing generation immediately afterwards. Other stations were instructed to be running at about full load and to be ready to reduce output rapidly on receipt of orders, as circumstances demanded, just before the silence. Some stations were warned to be ready to reduce output by a predetermined amount on receipt of instructions and to resume the same amount later, if and when instructed. In many instances a fall in output of 33⅓ per cent (in some, 50 per cent) was planned in this way, the value depending partly on the type of plant and the ability of the station to provide rapid changes in output.

Just before the silence, while the stations were reducing output according to the appointed programme, there was a corresponding rise in system frequency which tended to slow up the intended drop in output. Conversely, after the silence there was a rapid fall in frequency which reduced the rate at which load could be picked up. Because of the rapidly changing conditions, the effect of the rise and fall in frequency can be assessed only very approximately. However, the accompanying curves show that the total load fell from 9400MW to 7600MW, or 19 per cent, between 13.40 and 14.00 hours. Making an approximate allowance for the effect of frequency the drop in load would be about 21 per cent. From the curves it is clear that after the silence the national demand rose above the previous level at, say, 13.30, indicating the normal after-lunch recovery which had been deferred by the observance of the two minutes' silence.



Core and Coils for 120MVA Transformer for B.E.A. 275kV Transmission

Through close liaison between the system control engineers and power station engineers satisfactory control of transmission line loadings were maintained throughout the period of this special operation. To maintain this liaison all normal telephone traffic between system control and the power station was, of course, suspended for the time being, as was the normal programme for the economic loading of generating plant. From the point of view of the power stations the success of the operation can be assessed by the fact that at no time during the rapid load fluctuations did any boiler safety valves come into operation.



275kV Transmission Line Between Staythorpe and Barnby Moor

275kV and 132kV Transmission Systems

Work completed in the year ended March 31, 1952, to reinforce the grid system included the provision of thirteen new substations, with a net increase of 615MVA in the total transformer capacity. The main transmission works commissioned include 132kV substations at three new power stations—Poole, Skelton Grange (Leeds) and Braehead (Renfrew), with installations, respectively, of seven outdoor air-blast circuit breakers, seven oil circuit breakers and six low-oil-content circuit breakers of new design. In South Wales 18,760kVA out of a projected 30,000kVA of static condensers were commissioned. To cope with the additional load placed on the high voltage switchgear caused by the operation of new generating plant, two 132kV, 90,000kVA reactors were installed at the new Beddington (Croydon) and Dalmarnock (Glasgow) substations.

The principal transmission line works put in hand during the year ended March 31, 1952, included 145 route-miles at 132kV and about 218 route-miles at 275kV. Since then contracts have been placed with W. T. Henley's Telegraph Works Company, Ltd., for a line from Nursling to Velmore, Hants, and with J. L. Eve Construction Company, Ltd., for a line from Llantarnam to Crumlin, Mon.

The 218 miles of 275kV overhead lines consist of the double-circuit lines from Staythorpe (Newark) via Elstree to Slough, from Staythorpe to Drakelow (Burton-on-Trent), from Drakelow to Carrington (near Manchester), and from Drakelow to Hams Hall, near Birmingham ; the last named section will operate initially at 132kV. The total value of the transmission line contracts placed in 1951–52 was £27,700,000, including £10,600,000 relating to the 275kV system. The 41 miles of single-circuit 275kV line between Staythorpe and West Melton, for operation at 132kV initially, was completed. Construction was also in hand on 275kV lines from West Melton (Sheffield) to Stella (near Newcastle), Carlisle and Clyde's Mill, Glasgow, and from Tilbury to Elstree.

On this page we show a typical B.I. Callender's tower and part of the recently completed 275kV transmission line between Staythorpe and Barnby Moor, which is about 20 miles from West Melton. In last week's issue (page 19) we described and illustrated one of the straight-line towers which will carry the double circuit 275kV line from Tilbury to Elstree, a distance of 45 miles, over which the normal span length will be about 1200ft. The straight-line tower is 137ft 6in high and, in general configuration, resembles the familiar double-circuit 132kV tower. Apart from size, the principal difference in design is that the main legs, the main cross-arm members, and some of the bracings of the 275kV line towers are made of high-tensile steel, the remaining members being of mild steel. The towers are being fabricated by Painter Brothers, Ltd., for the J. L. Eve Construction Company, Ltd., the main contractor.

During the year orders were also placed for 7500MVA, 275kV switchgear for the super-grid and progress was made with the manufacture and testing of prototype equip-

ment. Preliminary tests on one 275kV air-blast design were satisfactorily carried out within the present limits of test plant capacity. To simplify production and maintenance a good deal of standardisation has been agreed upon with the manufacturers of such items as isolators, insulators and voltage transformers.

A series of orders were placed for nineteen 120MVA, 132/275kV auto-transformers for the 1955 stage of the super grid. In eleven of these transformers the tap-changing equipment will be insulated for operation at 132kV; in the remaining eight the tap-changers will be connected for operation at the neutral end of the windings. A second series of orders distributed between eight British transformer manufacturers was placed in June to cover twenty-three similar transformers required for 1956. Nineteen of these equipments will have high voltage tap-changing equipment and four will have their tap-changers connected at the neutral end of the windings. In the design of all these equipments the transformer manufacturers have co-operated with the makers of terminal bushings, towards the development of a standard interchangeable 275kV bushing of a re-entrant form, which favours a reduction in transformer size and weight.

The first transformer to be completed for the 275kV system is illustrated on page 63 from a photograph taken during tests at the works of the manufacturer, The English Electric Company, Ltd. For this transformer the impulse test peak values were given as 1050kV on the full wave and 1200kV on the chopped wave.

Another 275/132kV transformer for the same system is illustrated opposite, showing the wound core at the Rugby works of the British Thomson-Houston Company, Ltd.

The essential function of the first stage of the new 275kV system, which is due to be in operation in 1955, is to provide greater interconnection capacity between the main sections of the existing 132kV grid system. The remaining stage of the 275kV system is now being designed to meet requirements up to 1960, by providing further interconnection capacity and allowing later for some degree of bulk transmission from the coalfields to coal importing areas. All the lines south of Ferrybridge in Yorkshire, with the exception of the Staythorpe to West Melton, are being designed for operation ultimately at 380kV if required.

Interconnection on a still greater scale, between two national systems, is envisaged by the projected cross-channel cable which is being investigated jointly by Electricité de France and the British Electricity Authority. An interim report by the joint committee which is studying the project has been approved in principle by the B.E.A. and submitted to the Government for consideration, and a sum of £250,000, to be provided equally by France and Great Britain, has been allocated for preliminary research work on a pilot cable. An article presenting an appreciation of this interesting project was published in our issue of December 12th last.

Swedish 380kV Transmission System

In any assessment of progress in power transmission at very high voltages, pride of place must go to Sweden for developing, constructing and operating the first transmission system at a voltage of the order of 400kV. Sweden's geography provided the main incentive for adopting such a high transmission voltage, for the power must be transmitted in bulk over very long distances from the main hydro-electric resources in the north to the major load centres in the south.

The 380kV transmission that was devised to suit these special circumstances has been fully described elsewhere.* The main transmission line links the new power station at Harspranget, which has three 105MVA generating sets, with an intermediate station at Midskog, where power is picked up from Indalsälven, and with a receiving station at Hallsberg. At Midskog and Hallsberg there are connections to the previously existing 220kV systems through transformers which were described in a paper reproduced in our issue of July 18th. Harspranget power station and the Harspranget–Midskog–Hallsberg transmission line began operation in the spring of 1951, but, in the first instance, transmission was effected provisionally at 220kV. Early last year, however, the changeover to 380kV was carried out, and later in the year the system was formally inaugurated by the King of Sweden. The description of the complete system was brought up to date in a paper† by A. Rusck (president of the Swedish State Power Board), and B. G. Rathsman and G. Jancke. Reference was made in this paper to the decision to extend the 380kV network within the next few years, and details were given of some of the modifications that will be made in the design of the lines.

The intention is to build a new 380kV line to connect Hallsberg to a transformer station near Gothenburg and, thence, to a terminal station at Hälsingborg. Gothenburg will be at the mid point of this 440km line, which will be of the same design as that between Storfinnforsen and Enköping. It is expected that the Hallsberg–Gothenburg section of this line will be in operation by the autumn of next year. The remaining section is scheduled for completion at the same time, but it will be worked at 130kV for the first year, after which it will be operated at 380kV as soon as the terminal station at Hälsingborg has been completed. Another projected extension which should be in service by the autumn of 1956 will provide a third north-to-south line, about 700km long, to reinforce the existing 380kV system.

Various modifications will be introduced in the design of the projected lines, based on experience gained from the present 380kV system. First, the insulation level in the new stations will be reduced from 1775kV to 1500kV except in certain parts of the installation. Secondly, the loading capacity of the main 380kV lines will be raised by introducing series capacitors, an improvement which will probably justify the stringing up of a third conductor per phase in the near future. Auto-transformers rated at 3×155MVA will probably be used for the 380/130kV at the Gothenburg and Hälsingborg stations. This decision would imply the adoption of direct earthing for the neutral of the existing 130kV network and of extensive protective measures for the telephone installation.

*International Conference on Large Electric Systems (C.I.G.R.E., 112, Boulev. Haussmann, Paris). Paper No. 412, 1948 Convention; paper No. 410, 1950 Convention.

†C.I.G.R.E., 1952 Convention.

(*To be continued*)

The British Iron and Steel Industry in 1952

No. II—(*Concluded from page 31, January 2nd*)

THE development programme for the Corby works of Stewarts and Lloyds, Ltd., includes a new open-hearth shop, additional coke ovens, a new sinter plant, the reconstruction of the No. 1 strip mill, and new plant for the production of steel tubes by the electric resistance weld process. This last-mentioned plant, which came into full operation at the beginning of last year, was described in our issue of July 18, 1952. Tubes of from 1in to 4in outside diameter are now being produced by the E.R.W. process in lengths up to 36ft. A general view of the plant is reproduced herewith. All the strip used in the process is of cold-rolled open-hearth steel produced in the new open-hearth plant at Corby. This plant is housed in a modern building, 328ft long and 261ft wide, in the construction of which allowance has been made for extension in either direction. There are two 100-ton fixed open-hearth furnaces, which were supplied by the Wellman Smith Owen Engineering Corporation, Ltd., and which have been designed for firing with either liquid fuel (oil or tar) alone, a mixture of blast-furnace gas and liquid fuel, or a mixture of mixed gas and liquid fuel.

In the No. 4 sinter plant, which has been completed at Corby, close attention has been given to the method of offtake from the storage bins. The sinter raw material is spread on the hearth by a swinging hopper and shaking plate feeder. It was found that this design led to improved uniformity of bed depth and of the size grading of raw materials. After discharge, the sinter is screened to provide graded material for the blast-furnace burden, and, at the same time, a suitable amount of hearth bedding layer and return fines for the raw sinter mix. In the construction of the new sinter unit adequate provision has been made—by the use of the "Centicell" system—for cleaning the exhaust or waste gases from the plant.

One of the accompanying illustrations shows the reconstructed No. 1 strip mill at Corby. This mill has been converted from a cross-country strip mill to a straight continuous mill with a capacity of 450,000 tons of tube strip a year when rolling fifteen shifts a week. The mill, which has 19in diameter rolls, can accommodate strip of all widths from 5in to 16in and is intended to roll to a minimum thickness of 0·09in. At present its output is limited to the capacity of the existing finishing end plant, which is now being replaced.

Another project in the development programme of Stewarts and Lloyds, Ltd., on which a start was made before the end of last year, is a new tube mill at the Clydesdale Works, Bellshill, Scotland. The scheme, which is expected to be completed by 1955, represents the second phase of the company's plan for the extension of the Clydesdale steel works. The mill building will cover 8 acres, all under one roof, four bays—the longest of them 1250ft—running from the existing 100ft cooling tower towards new railway sidings which are being laid down. Alongside the outside bay there is to be a 20ft wide service road for motor traffic, and two railway tracks will bring in the raw materials from and carry the finished product to Mossend Junction. The plant will include an oil-fired furnace, 200ft long, for heating the ingots, the planned capacity

E.R.W. Tube Production Plant at Corby

being 35 tons an hour. A 750,000-gallon capacity water tower is to be constructed above the mill building, and the scheme provides also for the erection of a new power station. The existing tube mill at Clydesdale, for the production of large diameter tubes, has an output of about 1500 tons a week. It is intended that the new mill shall handle a similar tonnage.

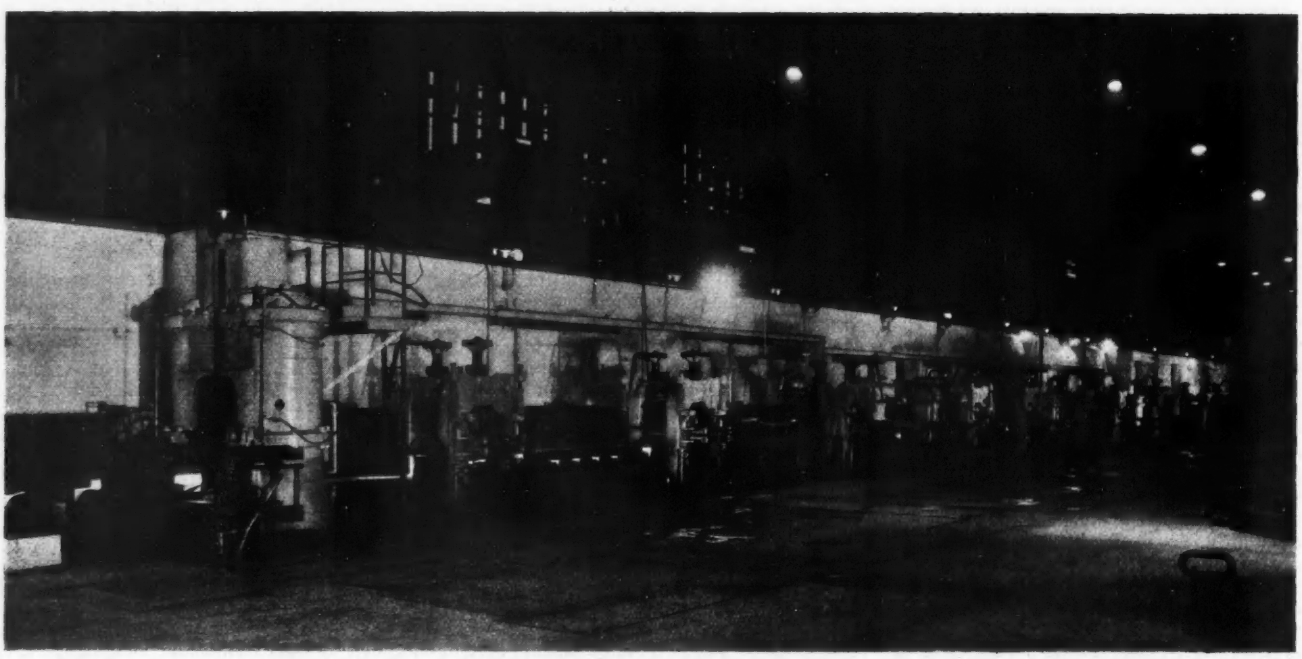
Other important work in the steel industry's expansion plan for Scotland is that which Colvilles, Ltd., has in hand. During last year a new coke oven and by-products plant was brought into service at the Clyde ironworks. This plant is capable of carbonising 10,000 tons of coal a week, which, being equivalent to 6000 tons of blast-furnace coke, has doubled the coke making capacity of the Clyde works and made them independent of outside sources of supply. The new plant—the total cost of which is put at rather more than £2,250,000—includes sixty-seven ovens arranged in three batteries, a by-product plant, and coal blending and storage facilities. The need for the plant was brought about by the addition of a third blast-furnace at the Clyde works in 1948. At that time, to meet the extra iron making capacity, much of the coke required had to be obtained from outside sources, some of it from as far away as South Wales, so that economic considerations made it essential to provide extra coke manufacturing facilities. A great deal of research was carried out on the suitability of the available coking coals, and, ultimately, in order to meet the high physical and chemical standards required, eighteen large blending bunkers were erected adjacent to the ovens. Each bunker has a capacity of about 1100 tons and, under normal operating conditions, twenty-six varieties of coal are blended, the majority of them coming from Scottish coalfields.

Between the coal tipplers and the blending bunkers a precrusher breaks the coal down to sizes under 1in. It is then fed through a hammer mill, where it is crushed to a fine state, 87 per cent being passable through a ⅛in screen, and passes on to the service bunkers, from which the ovens are fed. Together the service bunkers and blending bunkers in the works have a capacity of 30,000 tons of coal. The hot coke after discharge from the ovens is conveyed in an electrically operated coke car to the quenching tower, built in such a way as to eliminate as far as possible the release of objectionable gases to the atmosphere. From the wharf, where it is deposited to steam off, the coke is conveyed to the screeening plant, where the various sizes are separated, ¼in or over going directly into the blast-furnace bunkers. The by-product plant contains a number of innovations, including two self-cleaning decantation tanks, and two continuous sulphate centrifuges for the production of ammonium sulphate fertiliser. The benzole recovery plant has been doubled in size, special precautions having also been taken there to reduce the amount of fumes reaching the atmosphere. The completion of these extensions now makes Clyde ironworks independent of outside sources of supply as far as any part of the coke requirement is concerned.

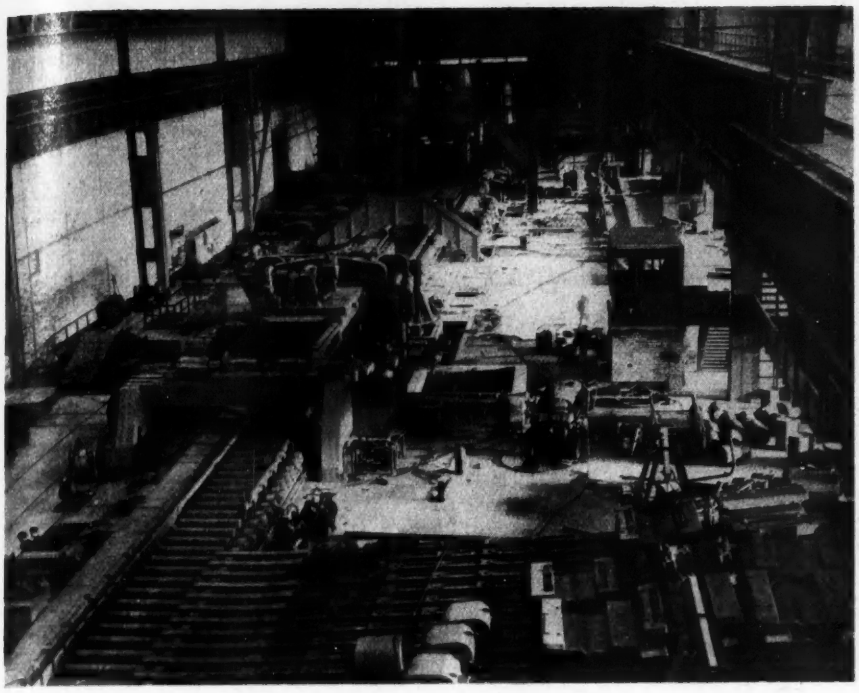
In the steel works considerable progress has been made in schemes for improving the finished product, one of the major items being the replacement of the present merchant and guide mills by a 20in merchant mill on the site of the original Dalzell Ironworks.

Work in progress in North-East England includes the extension schemes which the Consett Iron Company, Ltd., is carrying through in County Durham. In reviewing the progress of the iron and steel industry two years ago we made some reference—in our issue of January 5, 1951—to the Consett expansion project, mentioning in particular the coke oven plant, the additional blast-furnaces, and the new steel mills.

Before the end of 1951 further extensions were begun at the Fell coke works of the Consett Iron Company, Ltd., and last year work proceeded on the construction of an additional battery of seventeen Wilputte coke ovens complete with coal-handling



Reconstructed Strip Mill at Corby



Slabbing Mill at Consett Works

plant, oven charging and discharging machines, gas coolers, and tar and liquor-handling equipment. The ovens, which are of the compound underjet design, will increase the carbonising capacity by 2725 tons a week. They have three charge holes instead of the customary four. Coal for the new battery is to be taken from the existing bunker by a conveyor system delivering into a small hopper, which discharges direct into the coal lorry. A new 260ft chimney has been built and the fuel gas system comprises two fuel gas mains arranged along each side of the ovens at cellar level, provision being made for using the heat from the cellars to preheat the air necessary for the combustion of the fuel gases. The incorporation of double gas offtake mains, together with the rapid charging and shortened loading time effected by the three charge hole design, should result, it is believed, in almost smokeless charging of the ovens. A portal pusher machine, weighing 120 tons, is to be fitted with hydraulic door extractor gear to facilitate the handling of the self-sealing doors, and the coke guide is provided with hydraulically powered guide motions. The ovens are being built by Gibbons Bros., Ltd., the machinery being supplied by the Wellman Smith Owen Engineering Corporation, Ltd. The gas cooling system at the Fell coke works is being extended by the addition of a new gas cooler, and a new steam jacketed pipeline, 1970ft in length, has been constructed to convey crude tar from the coke works to the steel works.

In conjunction with the expansion of its blast-furnace plant, the Consett Iron Company, Ltd.—in collaboration with British Railways and the Tyne Improvement Commission—has built some new ore receiving bunkers. A new quay, constructed by the Commission at Tyne Dock, enables the rapid unloading of large ore vessels into bunkers discharging on to a conveyor, which, in turn, loads the ore into 56-ton wagons specially designed and built by British Railways. The wagons have side discharge doors, which are operated pneumatically from the locomotive. A train of eight or nine of these wagons can reach Consett two hours after leaving Tyne Dock, the railway line terminating over the new set of twenty-two reception bunkers which have a total length of 480ft. The bunkers, which were built by the Moxey Conveyor and Transporter Company, Ltd., are of welded construction with portal frame supports, and are lined with high-carbon wearing plates. They are fitted with double discharge gates operated by hand chain or pulley. The ore reception terminus, it should be added, is only part of the company's scheme for the rearrangement of the ore-handling plant. The foundations are now going in for a 300ft span ore bridge of 10 tons capacity and for two distribution bridges. The scheme includes also the provision of new conveyors to and from the ore stocking ground and the construction of a screening station and a new sintering plant.

By the end of last year the new slabbing mill at Consett, erection of which began in 1951, was nearing completion. The plant comprises new soaking pits and a Davy United slabbing mill, followed by a Morgan billet mill, and is capable of handling over 1,000,000 tons a year. The whole of this plant is housed in a steel-framed building situated to the north of the existing melting shop and plate mills. It has been erected on what was at one time a slag tip, and the layout of the plant enables the stripped ingots from the melting shop to have a very short and straight run to the soaking pits. Two batteries of four air/gas recuperative Stein and Atkinson soaking pits have already been installed and a third battery is now being constructed. Each pit is 25ft long, 12ft high and 8ft wide, and has a capacity of 20 tons an hour. The lids are of fabricated steel construction with a suspended brick lining and cast iron seal plates. The lid lifting mechanism runs in a steel track above the pits and lifts the lids clear for charging and discharging the ingots. Ingots of 20 tons, 15 tons and 10 tons can be handled by two 20-ton chargers and a general purpose 40-ton crane.

The ingots from the soaking pits are placed in a travelling car, which tilts them on to the ingot receiving table. They travel up to a turning and weighing machine which picks up the ingots clear of the table, turns them through 180 deg. and at the same time records their weight. The ingots then pass over the approach rollers to the new slabbing mill which has been installed by Davy and United Engineering Company, Ltd., and which is shown in one of our illustrations. It is a two-roll reversing mill, the 44in diameter rolls being driven by twin motors supplied by the English Electric Company, Ltd. The total lift of the rolls is 5ft. The manipulator heads are rack driven and are fitted with tilting fingers. An " up and down " shear, driven by two 1000 h.p. electric motors through a common gearbox, cuts the rolled slabs. The shear is fitted with stop and measuring gear and the crop ends are discharged into a crop pit, while the finished slabs go to a piler table. From the piler table the slabs are lifted by a slab chair, on to special wagons, which transport them to the new slab reheating furnaces adjacent to the existing plate mills. The slabbing mill is followed by a Morgan continuous billet mill, which has also been built by Davy and United Engineering Company, Ltd. The plant consists of a six-stand roughing mill and a four-stand finishing mill, provision being made for alternate vertical and horizontal control. The first group of six stands will produce 9in to 3½in billets and slabs from 24in to 9in wide and 2½in thick. The finishing mill produces billets 3½in to 1¾in and slabs from 8in by 2in to 4in by 1½in. Each stand is driven by a 1250 h.p. English Electric motor. A 66in hot saw, which is fitted with stop and measuring gear, cuts to the required length the finished products of the roughing mill. The products of the finishing mill are cut by

Casting Bay at Lackenby Works

an electrically driven flying shear, which is capable of cropping automatically the front end and dividing the billets or slabs into lengths between 33ft maximum and 14ft minimum. Two Stein and Atkinson slab reheating continuous furnaces have been put into service to replace the old "in and out" furnaces. One of the new furnaces can take 20ft slabs, while the other handles 12ft slabs. The slabs are taken by wagons to a de-piler, which pushes them into the continuous furnaces. The furnaces discharge on to a roller table, the slabs then being taken by a chariot which delivers them to the approach rollers of the existing plate mills.

Another important part of the Consett extensions, which was put into operation last year, is the plant for the production of basic refractories. This plant has been built on the south bank of the River Tyne at Jarrow, adjacent to the company's strip rolling mill.

In North Yorkshire, substantial progress was made last year on the second stage of the developments being made by Dorman Long and Co., Ltd., Middlesbrough. This second stage consists principally of the construction of an open-hearth steel plant on a new site at Lackenby. It is expected that the plant will be operating in the latter half of this year. By the end of last year the melting shop structure was virtually complete. It is over 1000ft in length and contains two fully active mixers of 600 tons and four tilting furnaces each of 360 tons nominal capacity. The installation of the furnaces, mixers, overhead chargers and other equipment is now well advanced and, in addition, engineering shops and stores, a power house, cooling tower and administrative and canteen blocks have been built. A point of special interest at Lackenby is the attention which has been given to the illumination at night of the rail sidings. By the erection of lighting towers, 150ft high, it is possible to floodlight large unobstructed areas.

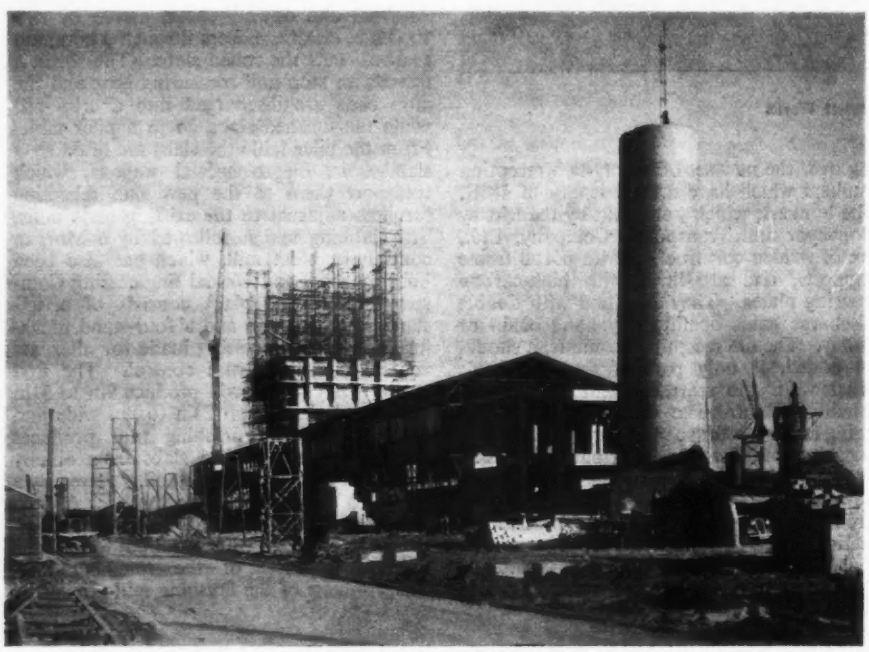
In the North-West, an extensive development scheme is in progress at the works of John Summers and Sons, Ltd., Shotton, Cheshire. When the project is completed, the company will have a fully integrated plant capable of producing annually 1,000,000 tons of ingot steel and converting it into strip and sheet. The scheme includes the installation of new coke oven batteries, together with an associated by-products plant, two additional blast-furnaces, ore-handling plant, sinter plant, a new melting shop and additional capacity in the rolling mills. An accompanying illustration shows the construction of some of the new coke plant in its early stages. One of the coke-oven batteries is now coming into production and the first of the two new large blast-furnaces will be blown in very shortly. Production is already taking place in the new melting shop in which there are eight 150-ton open-hearth furnaces and accommodation for two more furnaces if and when required.

In the first part of this review we dealt with the extensions which are being made at the Appleby-Frodingham works at Scunthorpe, Lincolnshire. Another development project at Scunthorpe is that which is now nearing completion at the Normanby Park works of John Lysaght's Scunthorpe Works, Ltd. In our reviews of the past two or three years we have noted the progress made with the Normanby Park scheme, which is based on a weekly production of 7000 to 7500 tons of pig iron, with an ingot capacity of 10,500 tons a week to produce blooms, slabs, billets and sheet bar. The necessary modifications and extensions to the melting shop have been carried out in three stages. The first stage, which was completed in July, 1951, included an extension to the melting shop building at the south end to house one new additional 120-ton fixed furnace, the enlarging of the next two existing furnaces to 120-ton capacity, and the widening of the pit bay from 54ft 6in to 70ft 6in, with the installation of one 175-ton ladle crane to handle 120-ton steel ladles. The second stage was carried out at the south end of the shop. It was completed early last year and comprised the widening of the pit bay to 70ft 6in over one mixer and four existing furnaces, two of which are 120 tons capacity and two of which were enlarged to 120 tons capacity. During this stage the second and third new 175-ton ladle cranes were erected in the widened pit bay. The final stage involved widening the pit bay in the centre portion of the shop over one mixer and two furnaces, one of which was enlarged to 120 tons capacity. This work was completed last July.

As each stage has been completed the plant has been brought into production under the final scheme conditions of casting into single ladle handled by one of the new 175-ton ladle cranes, serviced by new bogies fitted with roller bearings, each carrying four 4-ton ingot moulds, and fed to the parallel new stripping bay, which is serviced by two 6-ton stripping machines. Stocking, cooling, cleaning and changing of the ingot moulds is carried out in a new mould conditioning shop erected parallel with and adjacent to the stripping bay. The completed melting shop consists of nine 120-ton furnaces with two mixers, capable of producing 10,500 tons of ingots per week. Extensive new railway tracks and reception and despatch sidings have been completed to allow for a planned traffic flow system and to ensure a controlled cycle of traffic services to and from all departments. Well planned engineering and electrical maintenance shops have been brought into use, with modern welfare blocks for the men in the different departments.

Excellent progress was also made during 1952 with a new power scheme at the Normanby Park works, which on completion will entirely remodel the steam and electric generation services. Three new Foster-Wheeler high pressure boilers have been delivered to the site and their erection is well advanced. Each unit will be capable of evaporating 80,000 lb per hour at 625 lb per square inch M.C.R., using blast-furnace gas. Two new turbo-alternators of 5000kW rating will also be installed. Furthermore, all the site work has been completed ready to receive a second 65,000 c.f. per minute turbo-blower, to act as a stand-by unit for the one already in operation.

Finally, last July, site work was begun for the installation of No. 4 battery of twenty-three coke ovens, a coal blending plant and extensions to the by-product plant. This plant is scheduled to go into production about the middle of 1954, by which time there will be one battery of forty-seven ovens and three batteries of twenty-three ovens. After the putting to work of this new coke oven battery, arrangements have been made to rebuild the first portion of No. 1 battery of forty-seven ovens, which by then will be twenty-three years old. This rebuilding will be carried out in two stages. For a start, twenty-six ovens will be taken off and a division wall built to allow the other twenty-one ovens to remain in production. Rebuilding of twenty-three ovens will then be carried out from oven pad level. When that work is completed there will be one battery of twenty-one ovens and four batteries of twenty-three ovens, which will allow the rebuilding of oven batteries in rotation as the condition of the oven brickwork necessitates.

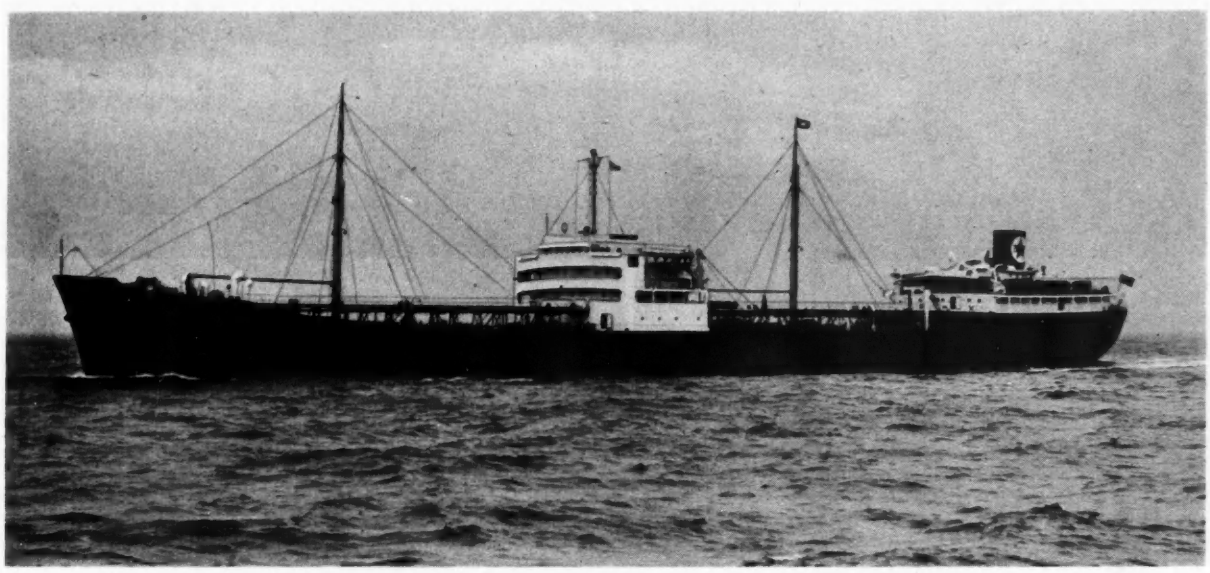


Early Stage of Shotton Coke Plant Construction

ANGLO-JAPANESE AIR SERVICES AGREEMENT.—Negotiations for an air services agreement between the United Kingdom and Japan were successfully concluded in Tokyo on December 29, 1952, the agreement being signed by representatives of both countries at the Japanese Ministry of Foreign Affairs. By this agreement the designated airlines of both countries will be able to operate scheduled air services between London and Tokyo, and between Singapore, Hongkong and Tokyo with certain extensions beyond. The United Kingdom airlines can now operate between London and Tokyo across the Atlantic in addition to their current scheduled services between London and Tokyo through India.

OIL TANKERS OF 1952

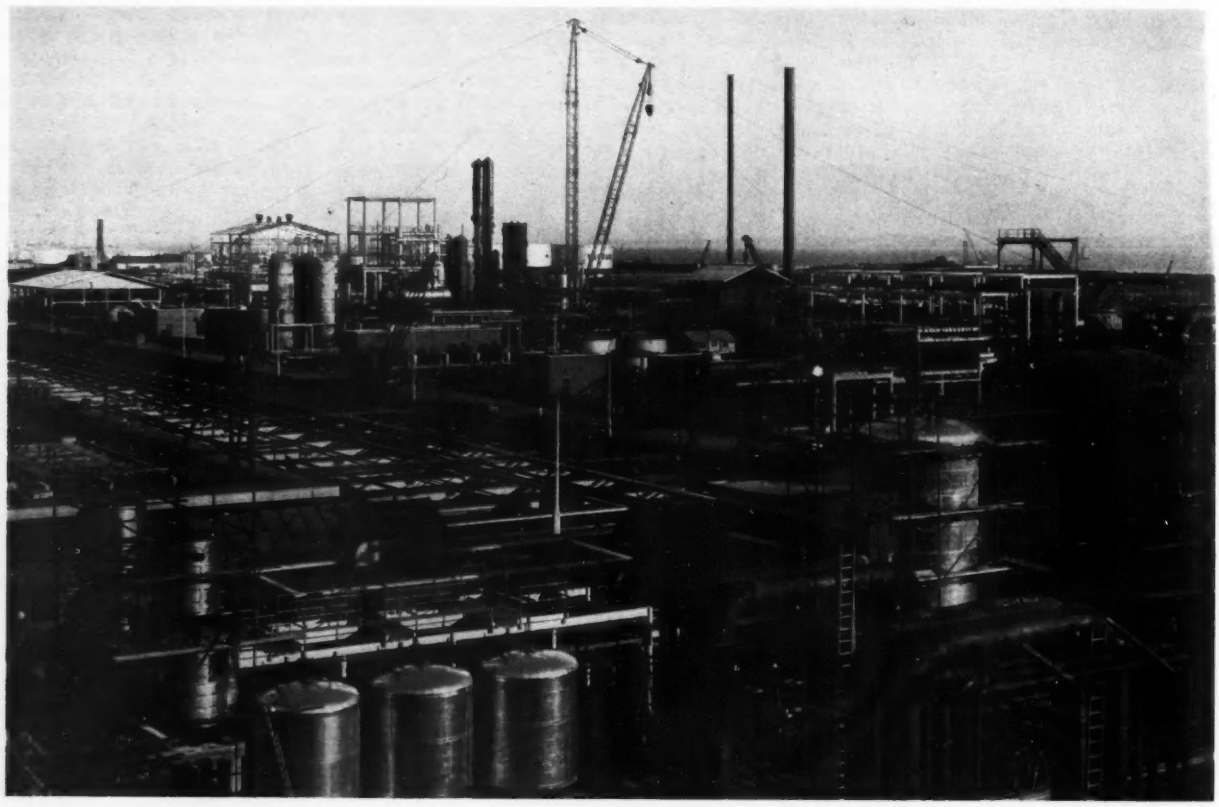
M.V. "Corato"



S.S. "Caltex Liverpool"

S.S. "World Concord"

OIL REFINERIES OF 1952



Coryton Refinery

Kent Oil Refinery

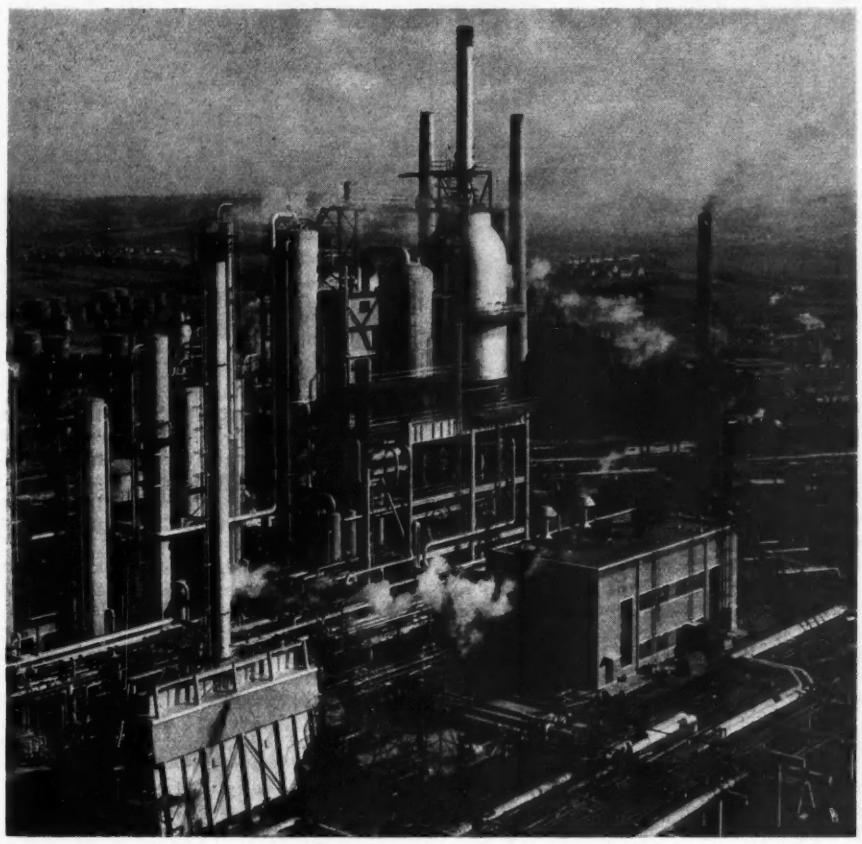
Oil Refineries of 1952

THE world demand for oil products continued to rise, and this was reflected in the steady demand for tanker tonnage and the number of oil tankers under construction. This amounted to about 250 ships, representing approximately 3,000,000 tons gross and 50 per cent of the total world construction, of which total some 100 ships of nearly 1,150,000 tons were building in Great Britain and Northern Ireland. Developments in Iran caused a loss of crude oil supplies, which has been largely compensated by the increased production from the oilfields in Iraq, Kuwait and other areas in the Middle East and elsewhere. Again, the reduction in refining capacity, amounting to 25,000,000 tons, resulting from the closing down of the refinery at Abadan, has been, in the main, offset by the progress of the refinery expansion programme in Europe. The pattern of development, which was initiated in the post-war years by the oil companies under the pressure of various economic forces, including the shortage of hard currencies and the pressing need to reduce the dollar content of the oil, continued to take shape. The scheme to build refineries at home, rather than at the source of supply, made considerable progress ; at several refineries additional units became operative and the new refineries at Isle of Grain, Kent, and at Coryton, Essex, were practically ready for partial operation by the end of the year.

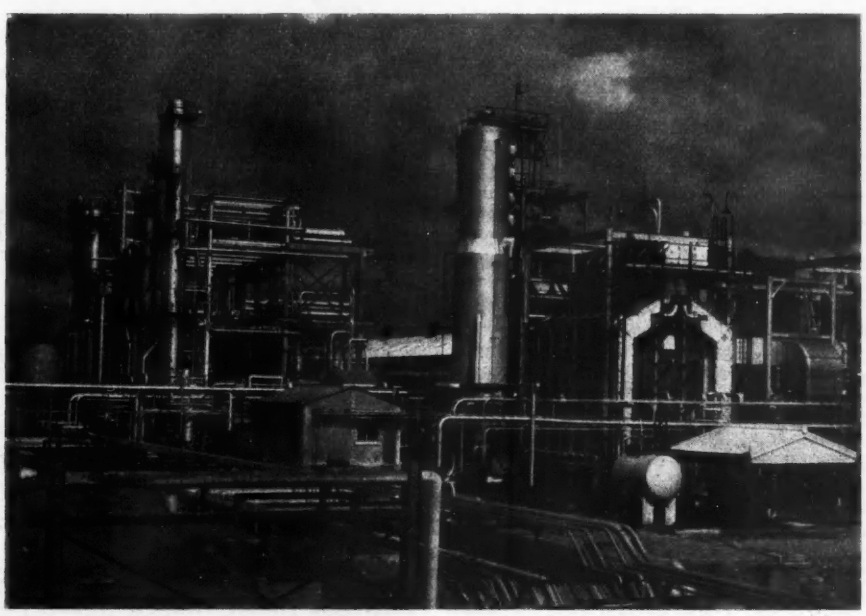
The refining of crude oil is now a major industry in this country, and is still expanding with two refineries yet to become fully operational and another, having an annual capacity of 1,000,000 tons, to be erected on the eastern side of Southampton Water for the Caltex Trinidad Leasehold group. The effect of the post-war policy of building refineries at home is clearly indicated by the quantities of oil refined. In 1946 the total was approximately 2,500,000 tons, three years later it had risen to over 6,000,000 tons and by 1950 the refining capacity had increased by a further 3,000,000 tons. A year later, with the completion of several major units, the annual rate had jumped to well over 16,000,000 tons, and when all returns for 1952 are included it is expected that the annual rate will have reached 24,000,000 tons. When the additional plants, at present under construction, are completed, and come on stream, it is estimated that Great Britain's refinery capacity will amount to nearly 27,000,000 tons per annum, and when topped crude and distillate capacity is included the grand total will be about 28,000,000 tons.

During the year the refinery building at the Isle of Grain in Kent, for the Anglo-Iranian Oil Company, Ltd., made considerable progress and the first cargo of crude oil was recently delivered to the tank farm. This refinery was planned to serve the London area and at present some 600 acres of the 2000-acre estate, which is mainly reclaimed marshland, is being developed at a cost of £40,000,000. The scheme is divided into three stages and phase one, consisting of the installation of a crude distillation plant and the necessary auxiliary units for the sweetening and blending of the main products, was completed. By the summer of this year phase two, consisting of a catalytic cracker and a vacuum distillation unit, shown in Plate 4, is expected to come on stream, to be followed at a short interval by the last phase, which includes a second vacuum distillation unit and a lubricating oil refinery.

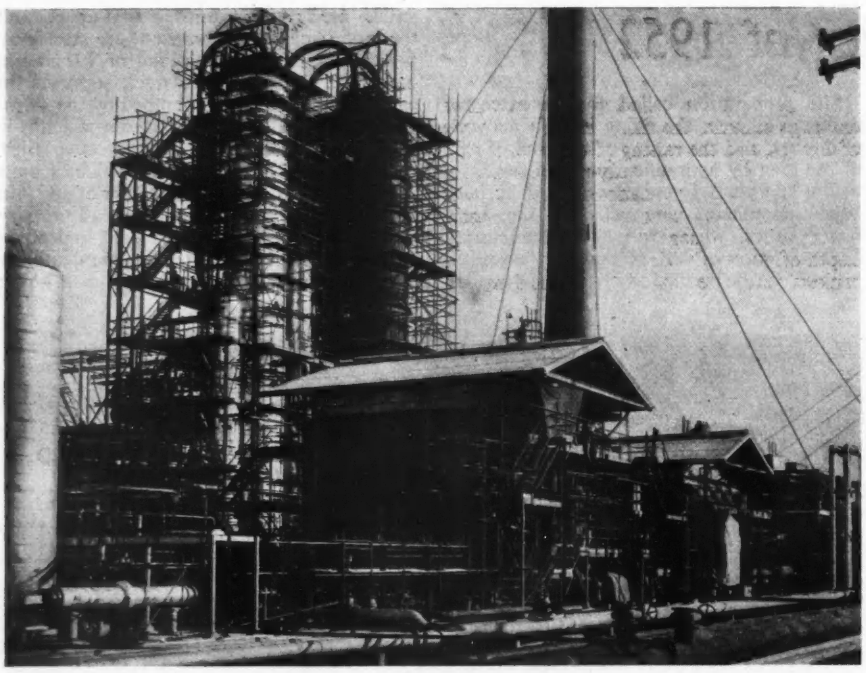
Site preparation called for an extensive drainage scheme, the filling in of a network of ditches, and the raising of the level of part of the area by hydraulically-placed sand fill, before the plant foundations could be laid. When complete, there will be four deep-water jetties, which will have a minimum depth of water of 40ft, so that the largest oil tankers can be berthed safely. The T-headed jetties are spaced about 800ft apart and the approach roads, carried on steel box piles, can carry a rolling load of 3 tons and have 14ft cantilever pipe track supports on each side. Crude oil is pumped by the ships' pumps to the storage tanks, from which it is delivered to heat exchangers before passing to the primary flash column, which is built in two sections, having diameters of 18ft 6in and 10ft 6in to produce an overhead primary flash distillate. This is condensed and piped to a stabiliser plant and then to the treatment plants; the resulting butane goes as a liquid



Llandarcy Refinery Catalytic Cracking Unit



Stanton Refinery Hydrocarbon Fractionation Unit and Cracking Unit



Coryton Refinery Crude Distillation Unit

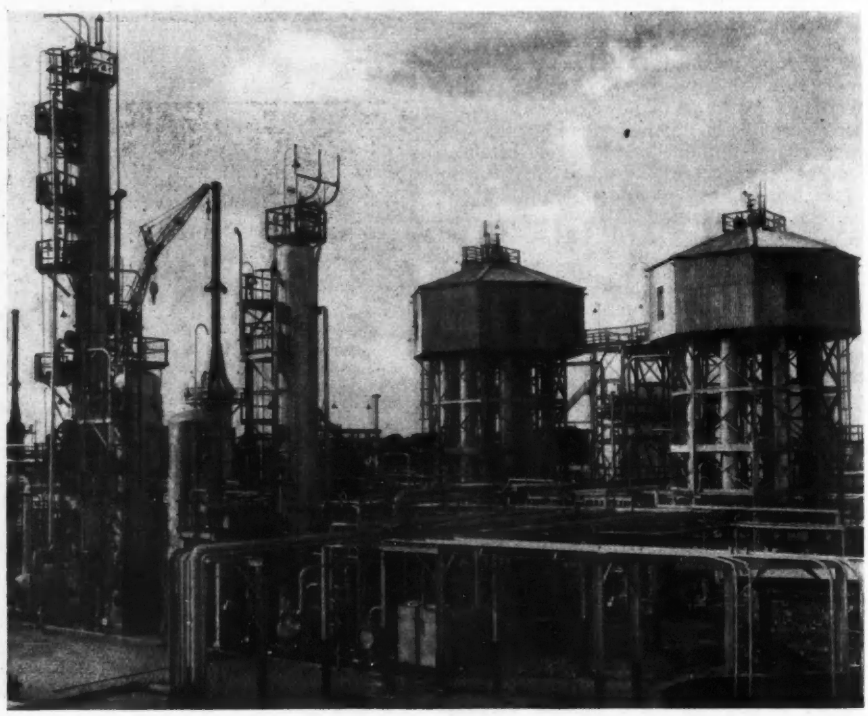
to the " Hortonsphere " and the gasoline to the sweetening units. The bottoms are raised in temperature in the primary and secondary furnaces before entering the atmospheric tower, 145ft high by 22ft diameter, where the various cuts are taken off and treated as required and the residue stored to form base stock for the vacuum units, one of which will provide feed stock for the catalytic cracking plant and the lubricating oil stock for the lubricating oil refinery. The various phases of the refinery project and details of the plant were described and illustrated in our issue of May 16th of last year.

At other refineries owned by the Anglo-Iranian Oil Company, Ltd., several additional units were practically completed by the end of the year. At Llandarcy, near Swansea, a new catalytic cracking plant, a photograph of which is reproduced on page 69, for treating heavy distillate oil from the vacuum distillation units, has been installed and will raise the present output of motor spirit from 500,000 tons per annum to 750,000 tons. Other equipment includes a sulphur dioxide extraction plant for the production of high-quality kerosene, and it is interesting to note that this unit is the first of its kind to be completely controlled electronically. The "Autofining" unit, which has a capacity of 175,000 tons a year and operates the catalytic process for the removal of sulphur, achieved its designed " desulphurisation" efficiency and is engaged in processing tractor vaporising oil. Work proceeded with the installation of several process units, including propane de-asphalting, Furfural solvent extraction, M.E.K. benzole dewaxing, and high-temperature clay treatment plants, which, when complete, will treble the present annual output of lubricating oils of 55,000 tons. The fifth and last of the new jetties, built of spun concrete, was completed and a new tank storage scheme made further progress.

The expansion programme at the Grangemouth refinery, on the Firth of Forth, operated by Scottish Oils, Ltd., was almost completed and the catalytic cracking unit is expected to raise the annual output of motor spirit from 370,000 tons to about 588,000 tons. This plant, together with the vacuum distillation unit and associated equipment, has cost £4,000,000, and work was commenced on two further units, namely, the "Girbotol" plant for separating the sulphurous gases from the others produced by the catalytic cracker and the catalytic polymerisation unit, which will polymerise the desulphurised gas to form motor spirit and " tetramer," an important intermediate in the manufacture of detergents. To keep pace with the increased production of the refinery plans were prepared to increase the capacity of the crude oil pipeline, connecting Finnart, on Loch Long, to Grangemouth, to more than 3,000,000 tons a year. For this purpose another pump will be installed at Finnart and it is planned to build a boosting pump house at Balfron, which is situated at the south-eastern end of Loch Lomond.

Adjacent to and closely linked with the Grangemouth refinery is the factory of British Petroleum Chemicals, Ltd., a joint enterprise of the Anglo-Iranian Oil Company, Ltd., and the Distillers Company, Ltd., where naphtha from the refinery is used to produce industrial alcohols and the by-products are returned for blending into the normal refinery production. Work proceeded with the construction of the factory for Forth Chemicals, Ltd., which is jointly owned by British Petroleum Chemicals, Ltd., and Monsanto Chemicals, Ltd., and early this year British Petroleum Chemicals, Ltd., will begin passing ethylene to the new factory for the production of monomeric styrene, a basic material for the plastics industry. The refinery at Pumpherston, also operated by Scottish Oils, Ltd., continued to produce oil from shale at an annual rate of 180,000 tons, and, based on the naturally occurring olefins in Scottish shale oil, special plant at the refinery manufactures the detergents " By-Prox " and "Comprox."

At the Coryton refinery of the Vacuum Oil Company, Ltd., of which a photograph of the lubricating oil units is reproduced in Plate 4, considerable progress was made during the year in the construction of the various units. "Dry" training was undertaken on the distillation unit and the thermal reformer, and crude oil was delivered to the storage tanks ready for refining. Laid out in the form of an L, the refinery, of which a preliminary description appeared in our columns on May 2nd last year, occupies 1400 acres on the north bank of the Thames, and for the present scheme 200 acres have been developed. The level of the area had to be raised and 10,000 piles driven to support the constructional work, while a special water intake jetty, described in THE ENGINEER of March 14, 1952, was built to supply the necessary cooling water. The atmospheric and vacuum towers of the two-stage distillation unit, of which we illustrated above, were practically completed and also the thermal reforming unit, while considerable progress was made with the erection of



Fawley Refinery Catalytic Polymerisation Plant

the "Thermofor" catalytic cracking plant and the various treating units. Cuts taken off in the first stage will, after treatment, be finished as motor spirit, while the gas oils will become diesel oil. The atmospheric bottoms will be charged to the vacuum stage where some gas oil will be produced, and the remaining cuts, three raw lubricating oil distillates and a residue, will be treated as necessary by the following units : propane deasphalting, furfural treating, M.E.K. dewaxing and percolation to produce finished lubricating oils, finished waxes and fuel oil. By the end of the year the construction of all four lubricating oil units was well advanced and they are expected to come on stream early this year. The power plant, consisting of three boilers linked up with three 5000kVA turbo-generators, was nearly completed and tests on electricity from the grid were undertaken.

The four refineries of the Shell Petroleum Company, Ltd., at Stanlow, Shellhaven, Heysham and Ardrossan achieved an overall capacity of 8,500,000 tons per annum. At Stanlow the refinery consists of three related groups, Stanlow North, Stanlow South and Stanlow Chemical Plant, the North refinery using paraffinic, asphaltic and minor feed stocks for the production of bitumen and a bulk luboil distillate, which is treated to produce luboils. The main construction programme of Stanlow South, of which we include a photograph of the hydrocarbon fractionating unit and the cracking plant, and which has a throughput of 3,750,000 tons per year, was completed last year, including a fluid bed catalytic cracking unit of 1,000,000 tons per annum capacity, and its complementary feed preparation unit. Part of the 300 penetration bitumen from the latter unit is now used as a bitumen feed stock by Stanlow North, in place of imported topped asphaltic crude. A polymerisation plant was added and will treat part of the olefins from the thermal reformer and catalytic cracker, while the other part will be used as feed stock for the chemical plant. In the completed sulphur recovery plant, which came into operation early last year, hydrogen sulphide is recovered in a Girbotol unit and then converted into elemental sulphur in a Claus kiln. The expansion of refining capacity called for a similar expansion in tanker berthing facilities, which is under construction at Eastham by the Manchester Ship Canal Company, and just outside the new oil dock area progress was made with the building of a tank farm, which will be connected to the refinery by a 16in diameter pipeline.

At the Shell Haven refinery, which was completed in 1951 and is operating at a capacity of 3,000,000 tons per annum, some additional vacuum-distillation facilities were installed for the production of a short residue, and this 300 penetration bitumen is pumped to the east refinery, where it replaces imported topped asphaltic crude as a feed stock for bitumen production.

With the completion of phase one the refinery, which was built for the Esso Petroleum Company, Ltd., at Fawley, on Southampton Water, came on stream in September, 1951. Since then work on phase two has made considerable progress, and when the new plant facilities are completed by the end of this year the refinery will have an annual capacity in excess of 6,500,000 tons. Construction was completed of a catalytic polymerisation plant (illustrated opposite) designed to produce additional quantities of high-octane motor spirit by the absorption of gases and low boiling point liquid by-products from the fluid catalytic cracking plant. Work was well advanced on three other units, including a tractor fuels plant for processing feed stock drawn from the fluid catalytic cracking plant to produce a premium grade tractor vaporising oil ; a sulphur recovery plant for utilising the high sulphur content of Middle East crude oil and designed to produce pure rock sulphur at an annual rate of 12,000 tons ; and a lubricating oils plant with a capacity sufficient to meet the demand for oils which have at present to be purchased for dollars.

In 1951 it was announced that plans had been prepared to increase the throughput of the Manchester oil refinery by 30,000 tons to a total of 150,000 tons per annum, and during 1952 progress was made in the erection of this plant. The new unit, which will work in conjunction with the existing vacuum distillation unit, is a fractionating tower, approximately 120ft high, capable of separating, within fine limits, the various crude oil fractions. It is expected that the new equipment, which includes a pump house and vertical up-draught heaters, will come into operation early this year and will extend the existing range of products by producing white spirit, gasoline, kerosine and gas oil and will also enable the refinery to use crude oil from the Middle East as well as from present sources in North and South America.

Coal in 1952

By SIR RICHARD REDMAYNE, K.C.B.

No. I

The European Situation

Of all the Continental countries, Germany heads the list in output of coal, the output of the Federal Republic for 1951 being of " hard coal " 118,900,000 tons, for the first time, since the end of the war, exceeding that of the year 1936, when the output attained to 117 million tons. The increase in the 1951 output over that of the previous year amounted to 7,500,000 tons. The number of workers at the coal mines was in 1951 greater than for the year 1936, varying from 438,000 to 455,200. The number of underground workers at the end of 1950 was 304,100, rising to 315,300 at the end of 1951. These figures are of importance in relation to the coming into being of the Schuman Plan. According to the German coal power estimate, a note of which appeared in the British Press of January 5, 1952, in 1951 the countries covered by this plan produced 251 million tons, of which Western Germany's share was 51·5 per cent.

It was announced at the beginning of July, 1952, from Geneva, that Britain was to export 2,330,000 tons of coal to Europe in the following three months, under a nineteen-nation agreement for pooling Europe's coal supplies by the United Nation's Economic Commission for Europe. The British quota was the third highest, Germany leading with 3,070,000 tons and Poland second with 2,621,000 tons.

The ministerial group, set up by the Council of the Organisation for European Economic Co-operation in January of 1952 to make proposals for increasing the production of coal to enable Europe to dispense with exceptional imports of coal, met in London on July 28th and approved its second report in which it re-examined the questions of production and consumption likely to be attained in 1952 and 1953. In its first report of March, 1952, the group had stated that, if the prevailing trends were maintained it was to be expected that the production would suffice to meet requirements and so dispense with exceptional imports by 1954, although a shortage might exist of special qualities of coal which might continue to be required from America. Tables of production showed that in 1952 Britain and Western Germany had increased the number of underground workers in the coal mines, in Britain by 14,500 and Western Germany by 5500, but in France, owing to improvement in manpower and output per man-shift at the mines, production had risen from 1294 kg in the first half of 1951 to 1351 kg in the first half of 1952. It was added that the lower output per man-shift in Britain, Belgium and the Netherlands compared with 1951 was largely due to the large number of untrained recruits in the coal mining industry.

It was announced from Geneva on August 10, 1952, by the coal trade sub-committee, U.N.E.C. for Europe, which met there during that week and examined the prospects for our solid fuel supplies for the last quarter of 1952, that the deficiency of coke would amount to about 1,300,000 tons, that the coal requirements of the importing countries would be about those of the third quarter, but that there was a net increase of European coal available for export of about 1,400,000 tons for the fourth quarter, compared with the third, that the United Kingdom had raised its export figure by 856,000 tons, and that exports from France and the Saar were substantially increased.

The theoretical deficit in European coal supplies was expected to be about 2,800,000 tons for the fourth quarter, as against 4,200,000 tons in the third quarter. It should be noted that this deficit does not take into account the imports from the United States of America to meet the continuing demand in the Continent for coking coal.

The European Coal and Steel Community

The Schuman Plan nations are now designated the Coal and Steel Community. We are concerned with it here only in so far as the coal industry is affected. It will be remembered that the Schuman Plan envisages the pooling of the coal, iron and steel production of Belgium, Holland, Luxembourg, Germany, Italy and France. At a conference of the foreign Ministers of the six countries concerned, held in Paris on July 24th and 25th last, it was decided to implement the treaty and to set up the coal and steel pool on August 10th and to make the selection of a permanent headquarters dependent on a settlement of the Franco-German dispute concerning the Saar. It was decided to adopt, in the meantime, Luxembourg as the seat of the pool and, when agreement was reached regarding the Saar, Saarbrucken as probably the permanent location. It was proposed that the French and German Governments should endeavour to come to a solution of the Saar problem along the lines of " Europeanisation " of the territory, and if by September 15th a solution had not been arrived at another conference should be held to consider the matter further. So the High Authority and Court of Justice came into being on August 10th, and it was decided

that the Assembly would hold its first meeting at Strasbourg on September 10th.

The Times correspondent stated (issue of July 26th) what " the announcement does not say is that if the Saar question is resolved by September 15th, four of the six Foreign Ministers of the participating nations will adopt the proposal originally put forward by Mr. Schuman, which caused surprise at the start of the discussions. This is that Saarbrucken should be the permanent headquarters of the Coal and Steel Pool, and Strasbourg a temporary centre."

The mineral resources of the Saar territory, which are leased to France, will pass into the Schuman pool and, as *The Times* in a leading article on the subject of its issue of July 26th pointed out, " when the Bundestag ratified the Schuman plan earlier this year, they added a rider requiring the Government to ensure political freedom in the Saar." Therein lay the difficulty in the amicable solution of the question. At the meeting of the High Authority held at Luxembourg on August 10th, the list of members, as announced by Monsieur Schuman (president of the Conference of Foreign Ministers) on August 9th, were Monsieur Monnet, the chairman, who would be assisted by two vice-chairmen, namely, Monsieur Coppé (Belgian Minister of Reconstruction) and Herr Etzel (chairman of the Committee on Economical Affairs in the Bundestag), the other members being Monsieur Leon Daum (managing director of a leading metallurgical firm in France and chairman of the Sollac Steel Corporation), Signor Giacchero (vice-president of the Italian Christian Democratic Party), Mr. Spirenberg (chairman of the Benelux and head of the Dutch delegation of O.E.E.C.), Herr Pothoff (head of the German delegation to the Ruhr Authority), and Monsieur Wehrer (the Luxembourg Minister in Paris). The ninth, co-opted, member, was Monsieur Finet (chairman of the Belgian Socialist Trade Union Federation).

The chairman of the Court of Justice is Signor Pilotti (a member of the International Court of The Hague and a former general secretary of the League of Nations). The names of the other judges were to be announced later.

It was pointed out that members of the High Authority cannot exercise any other professional activity, voluntary or paid, or retain any interest in any concern connected with the coal and steel industries during their term of office, and for three years after they have ceased to be members of institutions connected with the pool ; further, that they are independent of governments and solely responsible to the Assembly of the Coal and Steel Community, and that their decisions are subject to the judicial control of the Court of Justice.

Monsieur Jean Monnet, in his opening address, remarked, amongst other things, that the treaty that brought the pool into existence introduced the first " Anti-Trust Bill " in Europe, and that 155,000,000 customers would derive direct benefit therefrom, to whom will be available larger supplies and improved quality of coal, iron and steel. " We are determined," said Monsieur Monnet, " to engage in immediate and direct talks to find the way, as is the expressed wish of the British Government, to establish close relations between Britain and the New Community. We are convinced that close co-operation may be expected with the United States, which has repeatedly shown its sympathy since Monsieur Schuman launched his plan."

On August 22nd, the British Foreign Office announced that a British delegation had been appointed to the High Authority of the European Coal and Steel Community in Luxembourg, which would be led by Sir Cecil Weir assisted by Mr. James Marjoribanks, of the Foreign Office ; Miss Elizabeth Ackroyd, Under-Secretary, Ministry of Supply, and Mr. Charles de Peyer, Under-Secretary, Ministry of Fuel and Power, and that the delegation would include advisers from the coal, iron and steel industries representative of both management and labour. The delegation, which was to take up its duties forthwith, would report to the Foreign Secretary.

Monsieur Monnet, the president of the High Authority, visited London on August 21st to discuss with the British Government the relationship between it and the High Authority. He was informed of the desire of Her Majesty's Government to establish a close association with the Community and announced the intention to set up a permanent delegation at the seat of the Authority. The object of the delegation is the laying of the foundation for an intimate and enduring association between the Community and the United Kingdom and of dealing on a day-to-day basis with the many problems of common interest which will arise as the Community develops.

The personnel of the delegation appears to be an excellent selection. Sir Cecil Weir is a man of wide industrial experience and well versed in the iron and steel trade. He was economic adviser to the Control Commission in Germany from 1946 to 1949, and more recently chairman of the Dollar Export Board. Miss Ackroyd was seconded from the Ministry of Supply to be head of the steel section of the secretariat of the Economic Commission for Europe, and Mr. de Payer was secretary of the Reid Commission on Coal Mining. *The Times* Diplomatic Correspondent, in the issue of that paper of August 23rd, commenting upon the subject, said :

" It is clearly of great value that the British delegates will be associated with the High Authority on a day-to-day basis in its formative period. The precise terms in which the relation of British industries with the European community is visualised is not known ; possibly they have not yet been clearly formulated. But the architects of the authority would hope to extend the principle of the single market and the area of freer trade for coal, steel, and raw materials for steel-making. Although it has been rather cynically suggested that the association will take the form of market-sharing and price-fixing as in a cartel, this possibility is ruled out by the principles and purposes of the High Authority as these are envisaged by Monsieur Monnet.

" The association between this country and the authority will raise many practical difficulties ; this country's price-fixing arrangements may present an initial problem. But the results of this week's discussions provide a promising beginning."

Mr. Peter Roberts, M.P., in an important and well-informed letter to *The Times* of July 24th last, pointed out that danger to our industry from the European combination is not obviously apparent, but were there to occur a period of over production, more particularly in respect of steel, we might be faced in the United Kingdom by European subsidised competition ; for it must be remembered we are excluded, at present, at any rate, from the executive side of the venture.

On September 2nd the British delegation was welcomed by the High Authority and on the next day an American delegation arrived at Luxembourg, and the first session of the Council of Ministers was held under the Chairmanship of Dr. Adenauer, the Federal German Chancellor. In his speech he insisted that European unity should not tend towards centralisation but should be conceived on a federal or confederate basis ; and Monsieur Monnet, the President of the High Authority, stated that the High Authority would often consult the Council of Ministers, also emphasising the importance of the Assembly of the Schuman Plan, which was to meet next day, and he mentioned the importance of good relations between the High Authority and Britain and the United States of America.

The six nations involved in the Schuman Plan, France, Italy, West Germany and the three Benelux countries, were rapidly building up a confederal union based on the Schuman coal-steel pool. On the other hand, Great Britain had insisted that all union activities should be brought into the sixteen-nation framework.

A step towards the acceptance of the British proposal, Mr. Eden being present, was made after two days' debate by the Assembly at their meeting on September 14th, through a " Special Assembly " appointed to draft a plan setting up a six-nation Continental federation with a federal parliament and a federal cabinet, so that in any move towards a Federal Europe they must be closely linked with other nations. In the words of Mr. Eden, " The Special Assembly has taken a practical decision which will ensure that all members of the Council of Europe will be in continuous touch with the development of this project. This is in full accord with the spirit of the proposals of Her Majesty's Government."

It was announced in the Press of October 22nd last that the High Authority and the British delegation had issued in Luxembourg a joint statement in which it had been agreed to have a first meeting of a joint committee to work out the association of the delegation with the High Authority which would meet at Luxembourg during the week commencing November 17th.

The subject of the Schuman plan has been dealt with in some detail in this article as it constitutes the greatest and most important combination ever effected in the coal industry for production, marketing and price fixation, in Europe or elsewhere, and is likely to have extensive, and possibly serious, repercussions on our own coal, iron and steel industries.

It is difficult, too, to see how Great Britain can, short of becoming a full member of the community, exert a useful influence in guiding the actions of the pool in matters affecting production, distribution and price. The subject requires very careful and detailed study by the British delegation and the British Government.

Poland

Poland has for long been a strong competitor of ours in the coal export market and she is not a member nation in the coal-steel community. How and in what way the activities of that institution will be regarded by her we are as yet unaware, but there can be little doubt that the Polish coal industry will continue to compete strongly in the matter of exported coal. It was stated, for instance, in the Press of October 13th, that Sweden and Poland had signed an agreement by which Poland would export coal to Sweden at a price 10s. a ton lower than the British price.

The United States of America

The price of coal from the coal mines of the United States appears more likely to be increased than lowered for some time to

come owing to the advancement in wages to the miners—already the highest paid coal miners in the world—recently received. The 375,000 soft coal workers (soft coal as opposed to hard coal or anthracite) recently succeeded in securing a wage increase of 1·90 dollars a day and other benefits. On October 12th 5000 of the miners went on strike because the increase was not included in their semi-monthly pay-packets; the employers being unable lawfully to pay the increase until the wage stabilisation board had approved the agreement, the difficulty being that the increase is apparently 80 cents greater than can be granted without violating the existing wage regulations.

By October 20th more than half of the soft coal miners were on strike against the Government ordered cut in the advance they had obtained, but the president of the mine workers union, Mr. Lewis, requested them to return to work while the Government reviews the situation.

The British Coal Industry: Results for the Year 1951

The Ministry of Fuel and Power announced on January 1st that the estimated output of coal for 1951 was 222,117,500 tons, or 5,808,900 tons more than in 1950, and that the mined coal amounted to 211,131,800 tons (as against 204,123,500 tons in 1950), the opencast production being 10,985,700 tons (compared with 12,185,100 tons in 1950).

The miners output was slightly higher than it was before the war (the man-shift output during 1951 was 1·21 tons, as compared with 1·18 tons in the best pre-war year, 1936). But in view of the considerable increase in mechanisation which has taken place since then, one would have thought that the increase would have been much more marked. For between 1938 and 1950 the percentage of coal cut mechanically increased from 59·5 to 79·3 per cent, that carried by mechanical conveyors from 54·2 to 85·2 per cent, and power loaded coal from practically nothing to 3·2 per cent in 1949. Absenteeism continued to be nearly twice as high as in 1938.

The increase in wages to the miners towards the close of 1951 without a compensating enhancement in the price of coal adversely affected the financial results of the N.C.B., for, in place of a surplus comparable with the £8,300,000 obtained in 1950, there was recorded a deficit of £1,800,000 for the year 1951, although at the end of September there was a surplus of £3,300,000. Costs at the commencement of 1951 were slightly lower than in 1948 and the years following, but the general wage advances of January and December caused an increase in the production costs equal to half the total cost, thus accounting for a deficit of nearly £5,000,000 in the last quarter of that year. The total deficit since the Board came into operation stood at that time at about £5,800,000.

At the end of 1951, the wages of adult miners, including allowances, averaged at about £2 2s. 5d. a shift, as compared with 12s. 8d. in 1938. But it must be remembered in this respect that, according to the annual report of the Board for the year 1951, the cost of living had doubled since 1948. However, miners' wages had risen more quickly and increased to a greater extent than in the case of any other industry since the war. In the fourth quarter of 1951 wage costs per ton of coal sold amounted to £1 13s. 6d.

There had been a general rise in the cost of materials used at the mines, steel prices, for instance, rose by more than a fifth, and conveyor belting by nearly a third in 1951. More than half the rise in costs of materials from 1947 to 1951 took place in the latter year.

Owing largely to the comparatively mild winter of 1951–52 there was no trouble experienced in meeting the demands for the home consumption of coal, but had there been a larger production more coal could have been exported.

The Past Year: Financial Results

The quarterly statistics issued by the National Coal Board are at present only available in respect of the first two-quarters.* In respect of the statistical statements it must be borne in mind that they relate only to the mines worked by the N.C.B. and exclude those relating to mines leased in accordance with Section 36 of the Coal Industry Nationalisation Act which produced 1 per cent of the total quantity of saleable coal. The estimated financial results for the first two-quarters are as follows :—

	First quarter £	Second quarter £
Operating profit, collieries	8,832,368	3,147,437
Profit from ancillaries	1,075,000	820,000
Total	9,907,368	3,967,437
Less interest, loss on imported coal, and provision for taxation	5,758,000	795,000
Profit	4,149,368	3,172,437
Less interest payable to Minister of Fuel and Power	3,900,000	3,900,000
Profit + or loss −	+ 249,368	− 727,563

Thus, the financial outlook for the year is not a cheerful one.

Production

The output of coal from the mines worked by the N.C.B. during the first two-quarters of 1952 was as follows :—

	First quarter	Second quarter
Tonnage disposable commercially	51,338,759	48,530,091
Mine consumption	2,611,611	2,383,201
Miners' coal	1,484,258	1,222,977
Total tonnage	55,434,628	52,136,269

The figure of mined coal produced in 1951 —211,270,700 tons—was exceeded by about 1,500,000 tons in the year under review, and when the output from the opencast workings is added thereto the total coal output amounted to 224,939,200 tons compared with a total of 222,256,500 tons for 1951. Forecasts for the year 1952 put the production at 230 million tons, or about 14,000,000 tons lower than the year 1937. In that year there were 778,000 workers at the mines as against 717,000 at present. The output per man-shift (1·21 for 1951 compared with 1·18, 1938) is, however, in spite of the substantial increase in mechanisation, only slightly higher than it was before the war. Speaking in London on May 28th last Sir Henry Houldsworth, the chairman of the National Coal Board, stated that the quantity of coal cut by machines had increased from 142 million tons in 1946 to more than 170 million tons in 1951. In the near future we shall have to depend entirely for coal from our mines, as the deposits available for opencast quarrying are nearing exhaustion, and production therefrom is expected to continue for only about five years and at a gradually diminishing rate.

It was intimated in the Press of February 1st last that the National Coal Board would take over the responsibility for opencast coal production which had hitherto been administered under the direction of the Minister of Fuel and Power. One wonders why this was not done in the first instance as in the interests of both efficiency of management and saving in expense.

The Times, in a leading article, in its issue of May 29th, last sounded a timely word of warning in regard to the necessity of development according to the Plan for Coal, published in October, 1950, by the N.C.B., which envisaged a capital expenditure of £520 million, which would result in an annual output of 240 million tons by 1965, namely, £350 million in fifteen years to sustain the present output, and a further £170 million to bring up the output to the figure mentioned by 1965. "It is possible," stated *The Times* article, "to sacrifice this development work for a period in order to increase output; and the Board's report leaves it doubtful whether this has not, in fact, been happening."

Sir Henry Houldsworth stated in his speech in London on May 28th last that by the end of 1951 seven new collieries and sixty drift mines had been approved, and reconstruction schemes were to be undertaken at eighty-one collieries. But the figures of expenditure given in the Board's report for 1951 show an actual expenditure for 1950 and 1951 much less than was expended in 1949.

Costs of Production

The already high cost of production characterising the year 1951 continued to rise during the past year, chiefly due to the increase in the miner's wages. The figures for the available two-quarters of the past year as well as those of the last quarter of 1951 were as follows :—

	Total cost per ton s.	d.
Last quarter, 1951	52	1·2
First quarter, 1952	54	3·5
Second quarter, 1952	56	3·3

The cost of production of coal has steadily risen during late years, and as wages constitute over 60 per cent of the cost per ton, any further advance granted to the miners must increase that cost already dangerously high. Never before in the history of the British coal mining industry has it reached its present height. As coal enters so largely as an item of cost into the production of manufactured commodities and in transport by land and sea, any increase in that cost must necessarily adversely affect those industries to the detriment of the home market and as imposing a limiting factor in our competitive export trade, especially as regards iron, steel and coal itself, and so stultifying our efforts, nationally, to pay our way. Our only hope lies in an increase of coal production per man-shift. But in seeking to obtain it we will have to contend, in the future, with enhanced difficulties in respect of geological and physical conditions due to having to work the coal from thinner seams and deeper mines. It would appear evident that we shall have increasingly to rely on the more economical use of our coal supplies in order to meet the situation.

(*To be continued*)

* Figures for the third quarter are given on page 77.

Technical Reports

Some Investigations into the Behaviour of Compound Beams in Pure Bending: Research Report No. 14. London: Aluminium Development Association, 33, Grosvenor Street, W.1. Price 7s. 6d.—The use of aluminium alloys for the construction of ship superstructures has raised the problem of compound beams and to test the validity of the compound beam theory a series of tests was made on compound beams consisting of steel and aluminium alloy sections. A testing frame was designed and test pieces were subjected to known loads and the strains and deflections measured. Some fourteen composite sections were tested, the ratio between the areas of aluminium and steel ranging from 3·95 to 0·46, and some idea of the effect of length on the contribution of the alloy component to the compound beam was obtained. The bulk of the report consists of a description of the apparatus and of the tests for several of which the strain plot diagrams are included in the text, together with faired curves of strain-length of alloy. Possible solutions for disparities between strains derived from table and virtual inertia values are presented.

Contemporary Methods of Watch Production*

By R. A. FELL, M.A.,† and P. INDERMUHLE, A.M.I.Mech.E.‡

No. II—(*Concluded from page 36, January 2nd*)

The Turned Parts. The Sliding-headstock Automatic Lathe.—This type of automatic lathe was designed primarily for the production of long, slender components, such as balance staffs, where the length is considerably greater than the diameter. On such lathes the headstock slides along the bed, thus feeding the bar stock past the tools ; a steady bush for the bar is incorporated in the tool carrier. The main advantage of this arrangement is that the various tools, moving along slides perpendicular to the axis of the headstock, work very close to the steady bush and, owing to the fact that the work moves past the tool, the overhang is constant. The length of turning is, within reason, limited only by the available travel of the headstock on its bed.

Evidently the accuracy of the components is entirely dependent on the uniformity of the bar stock ; since the steady bush must be able to pass the top limit, and any smaller part of the bar is bound to be slack in the bush and ride away from the tools. For such high precision work, bars are often centreless-ground, and the steady bush is split like a collet for adjustment and lined with tungsten carbide.

There are generally five or six radial turning tools, disposed like the spokes of a wheel. The two lower tools are normally mounted on a common rocking lever, while the upper tools are held in individual slides. The rocking lever and each upper tool slide are operated by separate plate cams and levers.

Drilling, screwcutting and undercutting attachments may be mounted endwise on the bed, facing the steady bush. They are operated by segments of cams located on the free end of the main camshaft. The displacement of the headstock is controlled by either a plate or bell cam, through a system of levers and slides with adjustable ratios.

The front tool of the rocking lever is brought into position by a coil spring ; when turning, the tool is resting on an adjustable micrometer stop. The opposite tool is often used for parting-off.

The accuracy of the work performed by this type of automatic depends, among other factors, on the accuracy of the plate cams. However, their profiles are simple and the only parts which really matter as regards the accuracy of parallel turned diameters are the concentric portions. Since each tool holder is adjustable radially and axially by micrometer screws, the setting of the machine to very close limits can be achieved. The lever ratio for the rocking lever is 3/1 ; a rise on the cam is thus three times that of the tool. For the other tool holders and the headstock, it is adjustable between 1/1 and 2/1 ; so that errors of concentricity in the cams are reduced in the inverse ratio on the work.

The cutting tools may be made from ¼in to ⅜in square-section high-cobalt, high-speed steel ; however, this is now largely displaced by tungsten-carbide tipped tools. Diamond tools are sometimes used where small brass parts are to be made to very close limits and with high finish. Form tools are seldom used, but the parting-off tool (or any tool) might have a particular shape for a special purpose, such as, for instance, " radiusing " the end of a component.

The turned diameters of parts made on these automatic lathes are expected to be within ±0·0025mm (±0·0001in) for watch work. Machine tool makers have tried to improve these tolerances to satisfy the increasingly exacting requirements of the watch manufacturers, and an improved design has recently been marketed which is claimed to be capable of working to within 0·001mm (0·00004in).

Even more important than the peak degree of accuracy achieved on an automatic is its continuity of performance ; this is bound to depend on the wear of tools and steady bush, and the uniformity of the bar stock, quite apart from any inaccuracies in the machine itself. Components made on these machines include balance staffs, pallet staffs, pinion blanks, screws and pins.

The Wheels and Pinions. (a) *Indexing and Hobbing.*—Two main systems are used in the production of watch wheels and pinions : first, generation of the teeth by hobbing ; secondly, form-cutting—the blanks being indexed on an automatic machine. The hobbing method is, in general, applicable only to the wheels. Since it would be difficult, if not entirely impossible, to bring the hob to bear on a watch pinion, these must be cut by the indexing method. In certain cases, particularly when dealing with modules below about 0·15mm (diametral pitch approximately 160), difficulties are encountered in hobbing the wheels, and it may be preferable to cut them also with a single-row cutter. However, the hobbing of wheels of down to 0·07mm module (diametral pitch approximately 350) is now practised on the Continent.

The wheel blanks are produced by a compound press tool, which pierces out the crossings, forms the outside diameter of the blank, and in some cases also pierces a small hole in the centre. These blanks are threaded on a special work fixture which passes through the arms. As many as thirty or forty wheels may be cut simultaneously in this way ; and it is evidently quite impossible to cut watch wheels off an arbor, owing to the small size of the central hole. When a stack of blanks is being cut the formation of burrs occurs only on the last wheel, which is normally discarded. Work holders of this type are used whether the wheels are being cut by the hobbing or by the indexing method. Mainspring barrels are commonly hobbed in pairs, back-to-back. In either case, whether the hobbing or the indexing method is used, the hob or cutter is arranged to top the blanks, which are pressed out to an outside diameter

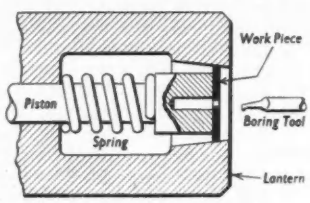


Fig. 10—Wheel Boring Lantern

perhaps $^{1}/_{10}$mm (0·004in) larger than that of the finished wheel.

The pinions are cut on an indexing machine, normally of Safag or Bechler type. In these machines a milling arbor carries one or more similar cutters, which operate on the blanks in turn ; the first cutter going perhaps only to two-thirds of the finished depth, the second or third cutter being used for finishing. In this way the work of removing the bulk of the metal is taken from the finishing cutter, which thereby preserves its form and sharpness for considerably longer and gives greater uniformity and better finish. The depths of cut are controlled by micrometer dead-stops, and the operations of indexing and changing cutters are entirely automatic.

A pinion blank for a typical wrist-watch pinion would have a diameter of 0·9mm (0·036in) into which would be cut seven leaves of about 0·11mm module (diametral pitch approximately 220). The pinion blank will have had its pivots formed during the turning operation and behind each pivot there will be a shoulder. The blank is held between special female centres on the pinion-cutting machine ; these centres have small clearance holes drilled at their apices, to clear the pivots, and conical recesses which bear on the shoulders. The centre in the indexing head is serrated with a special gashing punch, which is driven into it while still soft ; it is afterwards hardened and tempered and mounted on the indexing headstock. The tailstock centre is similar to the headstock centre except that it is not gashed, but its surface is highly polished after hardening. As it does not revolve, its upper side may be given a flat, to allow it to clear the cutter. It is pressed into contact with the pinion blank by springs ; the serrated centre mounted on the indexing head will therefore be capable of driving the pinion blank for indexing purposes. Special precautions must be taken in setting up the machine to ensure absolute coincidence of the effective axes of the indexing and tailstock centres.

The pinions are subsequently hardened and tempered in controlled-atmosphere furnaces ; it is of paramount importance that no scale whatsoever should be formed during the hardening process. They are then polished on a special machine with a wooden disc charged with a suitable abrasive. The pinion rests in two vees on a work-support ; the wooden disc has a shallow helical groove cut in it, so that when it is brought down on to the pinion it causes the latter to revolve. The disc is charged with a fine polishing abrasive such as a chromium iron or aluminium-oxide paste.

It is essential that the cutters or hobs used for production of watch wheels and pinions should have a very smooth profile. Marks on the profile of the cutter are bound to reproduce themselves on the flanks of the teeth of the wheel or pinion ; such marks cause unsatisfactory operation, since in a watch wheel-train the forces available are exceedingly small. The wooden-disc polishing process should be capable of removing all tool marks and producing a high polish in 7–10 seconds.

(b) *Wheel Centring.*—The central mounting hole in the wheel must be absolutely concentric with the pitch circle. Since a topping cutter or hob will have been used to cut the wheel, the tips of the teeth are bound to be concentric with the pitch circle ; the best possible procedure is therefore to define the central hole relatively to the tips of the teeth. Several methods may be used to achieve this result. For example, the central hole may be pierced or shaved in a special press-tool with an accurately made nesting plate to effect location from the tips of the teeth ; this may be tapered to overcome size variations. In some cases the hole is bored, the wheel being located from the tips of the teeth. For this operation a special lantern boring machine (Fig. 10) may be used, in which a solid taper chuck or lantern is used, in conjunction with a floating piston, to hold the wheel blank by its teeth tips during boring. It is essential that the taper of the lantern be ground from its own bearings, so machines for this work frequently have interchangeable quills, each permanently fitted with a lantern which is never disturbed after grinding. The hole may be bored to final size with a single-point boring tool if a central hole has been pierced in the blank ; or alternatively a three-spindle swinging tailstock may be used and the blank may be centred, drilled and bored.

(c) *Mounting the Wheels.*—Two methods are commonly employed for mounting wheels on their pinions. They may either be riveted to a shoulder formed on the pinion during the turning operation and provided with an undercut for riveting purposes, or, more commonly, if the hole in its centre is made a suitable size, the wheel may be driven on the shank of the pinion friction-tight ; in this case the shank should be slightly tapered.

Pivoting.—The pivots of the various watch arbors are turned over-size on the automatic lathe. The arbors are then heat treated and the pivots finally burnished to size. This last operation, " pivoting," is performed on hand-operated burnishing machines. The arbor is held in a small carrier driven by the headstock of the machine, while the pivot rests in the " U "-shaped groove of a burnishing bed. A revolving tungsten-carbide disc is brought into contact with the pivot and removes the excess material, leaving the surface highly polished. The depth of cut is controlled by an adjustable stop ; the operation takes only a few seconds. About 0·01mm (0·0004in) is removed. The pivot is driven at 1500 r.p.m., but, as its diameter is perhaps only 0·12mm (0·005in), the surface speed is practically negligible. The 2in burnishing disc rotates at 700 r.p.m., giving a cutting speed of about 350ft per minute.

The periphery of the disc is cross-grained and acts as a burnish file. It has to be regrained from time to time, with a cup-shaped diamond impregnated wheel, on a special dressing machine; the disc being transferred to the machine on its own quill, to ensure absolute truth in operation.

Some of the arbors of a watch, in any case the

* Paper. Institution of Mechanical Engineers, December 19, 1952.

† Consultant.

‡ Technical manager, Cyma Watch Company, Ltd.

balance staff, are mounted between end-stones. Consequently the ends of the arbors must be domed to reduce friction. The machine used for the doming operation is somewhat similar to a pivot burnishing machine ; but the burnishing disc is replaced by a spring-loaded tungsten-carbide flat file, to which is given a combined reciprocating and rocking motion. The pivot is supported on its cone or shoulder in a conical hole in a thin supporting disc. According to the amount of twist given to the file the surface generated can be varied from a flat to a hemisphere. The file works at 1200 strokes per minute

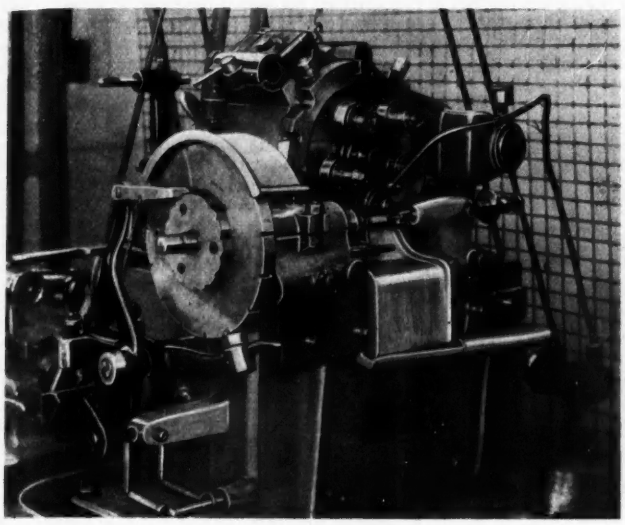


Fig. 11—Multi-Spindle Machine for Milling Teeth on Escape Wheel

and the " rounding off " operation takes about four seconds. To ensure uniformity of overall length, the arbor is often passed between two parallel grinding wheels on a length-correcting machine before being " rounded off."

The Escapement. (a) *The Escape Wheel.*—The manufacture of the club-toothed lever escape-wheel is difficult because of its small size and the shape of its teeth. The teeth are first milled on a stack of pressed blanks on a multiple-spindle milling machine (Fig. 11), usually with five or seven spindles. The spindles of this machine carry special fine-toothed form cutters and operate successively on the stack. The hole is next punched in the centre of the wheel, location being effected by a nesting plate from the discharge corners of the teeth. If the wheels are of good quality and made of carbon steel they are next hardened, after which a number of grinding and burnishing operations are performed. The teeth are chamfered, to reduce the width of the impulse plane to about one-third of the thickness of the wheel. This is effected on an automatic indexing machine, in which the wheel may be located by a conical point pressing in its hole or on a spigot projecting from the face of a special work fixture.

For indexing, either the work fixture may be indexed from a notched plate, as in pinion cutting, or the wheel itself may be indexed by an automatic head of somewhat complex design—location usually being effected from the heels of the teeth. The self-indexed system may be criticised because any errors of division introduced during milling or hardening are bound to appear in the finished wheel. However, in practice, both systems are used with success, the self-indexed system being the more common.

The locking and impulse faces of the wheel are then ground on basically similar machines, and in certain cases the heel of the tooth is also ground. In high-grade work a final burnishing operation is carried out on the impulse plane and sometimes on the locking face, with a disc made from a single piece of sapphire.

These grinding machines, although extremely simple in principle, are most delicate and troublesome to adjust, but when correctly set they will function for fairly long periods without major adjustment.

(b) *The Pallet-Frame, or Lever.*—The pallet frame is normally made of brass, German silver or steel. In better-quality work a steel pallet frame is normally used. Whatever the material, the outline is first obtained with press tools. The blank is pressed out over-size at all points, after which it is shaved through one or more dies to ensure precision of the contour and to obtain a greatly improved finish. The pallet-staff hole is next pierced, either by drilling or by punching, according to the thickness of the material at the appropriate point ; location being effected from the contour of the shaved pallet-blank by using precisely planted pins on a drilling fixture or press tool.

The notch and horns are usually milled next, on a special milling machine with two horizontal cutter arbors, mounted one above the other, and a rising work-table. One arbor carries a slitting saw, which cuts the notch, and the other a special fine-toothed form-cutter, which forms the horns. Location is taken from the pallet-staff hole and the outline of the blank near to the horns. The pallet slots may then be milled on a basically similar machine ; but with the milling arbors offset at appropriate angles, location being effected from the notch and the pallet-staff hole. Further milling operations must be performed to thin the body of the lever and the horns to the desired dimensions. It is necessary to de-burr the work at several stages.

If the guard pin is of the inserted-wire type, a small hole is drilled on a special machine, in a housing left standing during the milling processes beneath the end of the lever near the notch. The length of the guard pin may be determined by cropping off on a special fixture, location being taken from the pallet-staff hole. Alternatively, a hole may be pierced near the notch on the pallet-staff side, and a guard pin formed under the press may be riveted into position. The length of this guard pin is then determined on a special milling machine with two co-planar cutters and a swinging work fixture.

The pallet stones may then be inserted in their approximate positions, their ends being chamfered to assist insertion. The work is warmed on an electric hot-plate, and a small amount of shellac run on. The pallets are then transferred to the final positioning device, which consists of an optical projection apparatus. Location in the field of the objective is effected from the pallet-staff hole and the notch. The base on which the pallets lie during this operation is electrically heated, so that the shellac is softened ; pusher fingers may be used to force the stones back into their slots until the pallet faces are seen to lie between the pairs of limit lines on the projection screen. Alternatively, a simple mechanical arrangement using micrometer stop pushers may be used; both practices being satisfactory.

To-day the pallet staff is generally pressed into position, the size of the hole and staff being such that an interference fit is obtained.

(c) *The Roller.*—The manufacture of the roller is considerably simpler. The roller blank is first turned on a sliding-headstock automatic lathe ; both large and small rollers being formed from the solid bar with a groove between. The hole to receive the balance staff also is drilled on the automatic. The next operation is to pierce a " D "-shaped hole for the impulse pin with a press tool, location being taken either from the hole or from the circumference of the large roller. The passing hollow is then milled on a small special-purpose machine with a side cutter of radius equal to that of the passing hollow. The position of the hollow is made to coincide with the centre-line joining the central hole and the impulse-pin hole, location being taken from these two.

The insertion of the impulse pin is carried out on a special fixture which locates the roller from the central hole and the " D "-shaped hole. The impulse pin is then inserted with a pusher which moves along a " V "-shaped slot in which the pin is placed ; this is so aligned that the pin will enter the " D "-shaped hole in the roller. The pin is finally secured by warming the roller on a hot plate and applying a touch of shellac.

In high-quality work the roller is made of hardened steel, and the edge of the small roller and the passing hollow are highly polished. It is desirable to have the edge of the small roller polished to reduce any friction consequent upon the operation of the safety action. In work of ordinary quality a brass roller is normally used ; in many cases it is quite adequate, but a steel roller is less liable to damage during repair.

The Balance. (a) *Material.*—Two types of balance are in use in watches to-day : the bi-metallic compensation balance and the mono-metallic uncut balance. The use of the bi-metallic balance is rapidly decreasing.

The mono-metallic balance is made in one of several materials, according to the class of watch. For the lowest grade work a brass balance is used, while better balances are made of German silver and beryllium copper. Beryllium copper is probably the best material available to-day for a mono-metallic balance, because it is hard and therefore comparatively insusceptible to damage when a staff has to be changed. It is also non-magnetic. It has no special temperature-compensation properties.

The balance (Fig. 12) usually has about sixteen screws on the outside of its rim, which provide a very convenient means of changing both the poise and moment of inertia of the balance during adjustment at the factory, or after repair ; thus the mass of the balance may be increased by fitting timing washers under the screw heads, or decreased by removing metal from them in one way or another.

(b) *Turning, Piercing and Boring.*—The problem of balance manufacture consists in turning, piercing and boring the balance blank to form a hollowed-out wheel. Holes must subsequently be drilled and tapped in the rim to receive the balance screws. In some high-grade watches two or four mean time screws are fitted; one is placed at each end of the arm and, if four are provided, two at right angles also. These are fitted friction-tight in the holes in the rim, so that they may be moved by the adjuster to effect

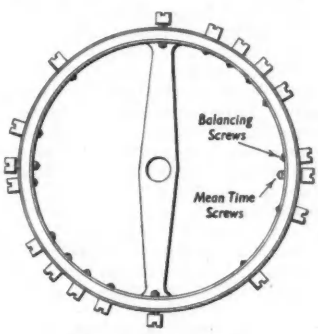


Fig. 12—The Balance

small changes in poise or mean time ; such a friction fit is difficult to achieve in production. Their provision in wrist-watch balances is relatively uncommon.

In making a mono-metallic balance, a round blank is first stamped out from flat strip. This is subsequently recessed in an automatic facing lathe of the chucking type, after which the " D "-shaped openings are pierced simultaneously with the central hole by an accurately made press tool ; it is important that the balance should be symmetrical. The balance is then chucked from the inside and the outside diameter is turned, the back skimmed and the hole bored ; the edge is frequently turned with a diamond to ensure high finish and accuracy. It is then chucked externally and the upper side of the

rim is faced and chamfered, again with diamond tools.

The balance is next mounted on a special automatic indexing machine, and the screw holes are drilled in the rim ; tapping is generally carried out manually on a small and very sensitive tapping machine and requires considerable skill. In balances for high-grade watches, the shear marks left on the inside of the rim after the piercing of the " D "-holes are removed by filing.

(c) *The Balance Screws.*—Balance screws are turned on a small automatic lathe ; the threaded portion is exceedingly small, about 0·3mm ($^1/_{64}$in) in diameter, with a pitch of 0·1mm (254 threads per inch). The weight of a typical wrist-watch balance screw is about 1 milligramme. In work of ordinary quality the screws are of brass ; gold screws are used in high-grade watches, particularly in those fitted with bi-metallic balances intended for careful temperature adjustment. Balance screws are sometimes machined with diamond tools and thus delivered ready-polished from the automatic lathe.

(d) *Balance Mounting.*—All the careful work carried out in the manufacture of the balance will be compromised unless great care is taken in mounting it on the staff. The riveting of the undercut part of the balance staff must be carried out with extreme care, the balance being revolved under the riveting punch while the blows are applied. Alternatively the rivet may be spread by rolling, and this might be expected to give more satisfactory results. However, it is essential for the success of this process to hold exceedingly close tolerances on the diameters of both staff and hole.

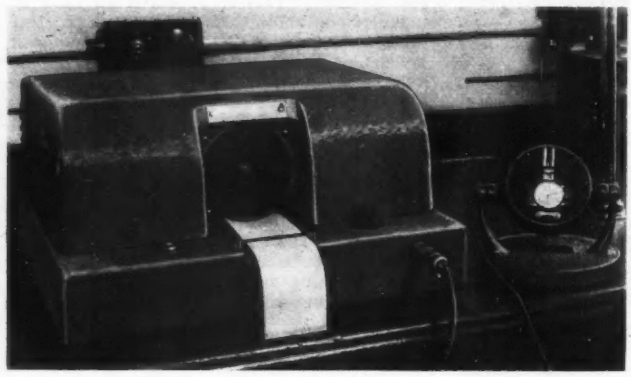


Fig. 13—*Watch Timing Machine*

Assembly, Timing and Performance. (a) *Order of Assembly.*—The final assembly of finished watch-components or sub-assemblies calls for the greatest possible care and cleanliness at every stage. The detailed procedure for assembly varies considerably among different manufacturers and countries, according to the type of labour available and the quality of watch.

However, the following would be a fairly typical procedure : it is assumed that all sub-assemblies have been completed ; that is, that the parts have been mounted true and flat—the wheels on their pinions, the balance and roller on the staff, the mainspring in the barrel, and the pallet stones and guard pin in the lever.

The first stage is to assemble the wheel train in the plate, from the centre wheel to the escape wheel, and put the bridges and cocks in position. End-shaking and the freedom of the train are checked at this stage.

The next step is to assemble the mainspring barrel under the barrel bridge and put in the keyless work ; up to this stage of assembly the pivots, or keyless work, have not been lubricated.

The balance and escapement are then assembled, the pallets being checked by the assembler for correct height relative to both the escape-wheel and the roller. The balance must be carefully checked for end-shake.

(b) *Oiling.*—To-day, the balance spring will have frequently been matched to the balance at this stage—that is, colleted, trued, vibrated and studded—and the watch may then be oiled, great care being taken to apply the exact quantity of the right type of oil only where it is wanted. The most important parts to be lubricated are the balance jewels, train wheel holes, pallet stones, and certain points in the keyless work. The mainspring will have been lubricated previously, during its insertion in the barrel. The quantity of oil needed at the balance pivots is exceedingly small ; this oil is retained by surface tension between the convex upper surface of the balance-hole jewel and the flat under surface of the end-stone, which must be separated by a critical distance of about $^2/_{100}$mm (0·001in). The weight of oil held in the balance jewels of a typical wrist-watch is about 0·005 milligrammes; if correctly applied, this is sufficient to keep the watch in service for one and a half to two years. It is absolutely essential therefore, to use the best oil, one which has been tested rigorously under actual conditions of service for several years. The oil must be carefully stored and small quantities of fresh oil put out for each assembler's use at frequent intervals.

(c) *Springing and Timing.*—Owing to small variations in the dimensions of both balance and spring, which are inevitable in manufacture, it is necessary to vibrate each spring individually with the balance with which it is to work. A variation of 0·00025mm (0·00001in) on the thickness of the spring wire is sufficient to cause a change in effective length of as much as a quarter of a turn.

Vibrating is carried out by putting a colleted and trued spring on the balance staff ; the roller must be in position at this stage. Two main methods are now used for vibrating. In one, a standard balance and spring are mounted in the base of a vibrating tool, on the upper part of which is fitted a pair of fixed tweezers or rollers to grip the spring under test. The base of the tool can be given a sharp rotary motion, exciting both balances into oscillation. By observing the arms of the two balances it is possible to see quickly whether any adjustment to the length of the spring under test is required. The point on the spring gripped by the tweezers or rollers will be the point at which the curb pins should lie when the spring is in the watch. Before cutting off, an allowance must be made for pinning in at the stud.

In a second and more rapid method, used in production over the last ten or fifteen years, signals are obtained from the balance under test and compared stroboscopically with a source of standard frequency—usually a quartz or fork-controlled oscillator. The simplest method of obtaining the signal is by direct contact between the lower pivot of the balance under test and a metal plate on which it taps as the spring coils and uncoils, thus causing the balance to rise and fall. The average length of time taken to vibrate a spring to within half a minute per day is approximately 1½ minutes.

After vibrating, it is necessary to bring the watch to time in two or more positions, according to the quality of the work. The balance must be accurately in poise and this condition is normally achieved by removing metal from the screw heads. The balance is poised on a poising tool, which generally consists of a pair of parallel knife-edges. The heavy point of the balance will then tend to sink to the bottom and at this point metal must be removed until the balance will remain stationary in any position. Machines have been developed for poising in which the knife-edges are replaced by half-jewel bearings ; these are vibrated to reduce frictional effects, and a small rotating cutter is used to remove metal from the screw that has sunk to the bottom.

Rapid observations of rate are greatly facilitated by the use of a timing machine, Fig. 13 The basic principle of all timing machines is the rapid comparison of the movements of the oscillating system of the watch with a standard oscillator. Such machines are made commercially and the best types print a record from which the instantaneous rate may be readily deduced ; some machines allow the record to be made for thirty seconds only, while on others it may continue indefinitely—in practice, for perhaps two or three minutes. The escapement sounds, or " ticks," of the watch are picked up by a microphone ; these are amplified and used to operate the printing mechanism.

The use of machines of this kind saves much time when adjusting any watch. In general, the standard oscillators used can be relied upon to within one or two seconds per day, but it is reasonable to say that for precision adjustment —that is, closer than ten seconds per day— there is no alternative to long-period observations of a watch in the required positions.

The records of timing machines may be used also, if studied with great care and intelligence, to reveal certain faults in the mechanism. However, such conclusions should invariably be backed up by careful visual scrutiny.

Conclusion

The modern fifteen-jewelled man's wrist-watch can be divided into three main categories, the price varying accordingly. The most ordinary category will have a flat balance-spring and perform to within perhaps one or 1½ minutes a day between the hanging and lying position. Better-grade fifteen-jewelled watches will perform to within thirty seconds or one minute between hanging and lying, while commercial wrist-watches of the best grade should perform to within about twenty seconds per day in five positions and over a range of about 30 deg. Cent. (86 deg. Fah.). The last result is by no means easy to achieve, and calls for much skilful and painstaking work in the final stages of assembly and adjustment.

A watch of this type in a water-tight case should retain its accuracy for up to two years after being cleaned and oiled. Obviously, if the user of any watch wishes to obtain the best performance from it, he must return it to a thoroughly competent repairer for cleaning and oiling at least once every two years.

The ultimate performance obtainable at present from a wrist-watch constructed and adjusted with the greatest possible care and regardless of expense can be seen from Table I to be remarkable. These figures relate to the performance of a watch with a movement 30mm in diameter, tested in 1949 at the Observatory of Neuchâtel.

Table I—*Performance Figures for a Wrist-watch*

Position of watch	Rate, seconds per day	Departure, second
Crown left	+0·92	±0·36
Crown up	+2·07	0·57
Crown down	+0·30	0·55
Dial down	+0·77	0·27
Dial up	−0·15	0·35
4 deg., dial up	−1·30	0·20
18 deg., dial up	−0·50	0·10
32 deg., dial up	−0·10	0·25
18 deg., dial up	−0·17	0·17
Crown left	+0·95	0·15

The results obtained with precision pocket-watches are considerably better, the stability of rate and performance in various positions and temperatures often being within about one part in a million.

Rubber Bodies for Wheelbarrows.—We are informed by the Dunlop Rubber Company, Ltd., that it is now making rubber bodies for wheelbarrows. The thickness of the rubber used for the bodies varies according to the purpose for which the barrow is designed and the body is fastened to a skeleton steel frame mounted on the chassis. Tests prove that the flexibility of this kind of body prevents damage when a barrow is used for transporting fragile goods and where its contents tend to stick. For all practical purposes the rubber body of the new barrow is not affected by acids or alkalis, and it is stated to be both lighter than the ordinary barrow and to stand up better to rough work.

Building Exhibition at Bolton.—On January 15th the Minister of Works will open the Modern Building Exhibition to be held at Bolton Technical College. The exhibition, which will remain open until January 21st, is being organised by the Ministry of Works and supported by the Bolton Education Committee, the Ministry of Labour and National Service, Bolton Corporation, the employers' and operatives' associations, and the Local Joint Apprenticeship Committee. Ministry of Works exhibits will include " Building Research and Housing," " Domestic Plumbing " and " Careers in Building." There will also be exhibits of local interest.

Industrial and Labour Notes

Production in the U.S.A. and Canada

The Department of Scientific and Industrial Research has just published, through H.M. Stationery Office, *A Survey of Production and Industrial Engineering Organisation and Practice in the U.S.A. and Canada.* It has been prepared by Mr. T. G. Elliott, who, from May, 1949 to August, 1951, was mechanical engineering liaison officer with the United Kingdom Scientific Mission in Washington. During his stay there, Mr. Elliott was able to visit a number of American and Canadian industrial organisations, observe their methods, and talk with their technicians and executives. His visits included automobile manufacturers, machine tool plants, iron-foundries, textile machinery makers, manufacturers of heavy electrical equipment, agricultural machinery makers, mass producers of light electrical equipment, and aircraft manufacturers. In addition, Mr. Elliott went to universities teaching production and industrial engineering and attended meetings of several professional societies and other technical bodies.

Naturally, a great deal of the information contained in the survey is very similar to that given in the reports of the industrial and specialist teams from this country which have visited the U.S.A. in recent years under the auspices of the Anglo-American Council on Productivity. None the less, Mr. Elliott's impressions are both useful and interesting. The material has been classified in nine sections covering buildings and factory layout, machinery and equipment, mechanical aids, standardisation, production control, research and development, management and technical personnel, availability of raw materials, and supply of labour. Under this last heading, the survey says that, prior to the outbreak of the war in Korea, there appeared to be a plentiful supply of good labour in most of the big production centres. It will be interesting to know, Mr. Elliott comments, where labour to operate an expanding industrial machine will come from. Efforts are being made to use machinery in place of manual labour where possible, and there was some evidence of recruiting women, especially in the expanding aircraft industry. Mr. Elliott noted that the standard of timekeeping was good in all factories, and that labour appeared "to keep on the job" during working hours. The normal hours are forty, worked in a five-day week, and usually paid on a flat hourly rate. That rate varies in different parts of the U.S.A., being highest in the middle and far western states and lowest in the south-eastern states.

Mr. Elliott also refers to the progressive view of technical improvements which is taken by the unions in the U.S.A. and Canada. The unions, he says, subscribe to the theory that industry should be encouraged to improve its methods and reduce its costs, since in the long run that means more jobs and better wages. But, the survey adds, in many industries and trades there is considerable labour unrest, notably in coal mining. Most of the strikes, however, are of short duration and frequently coincide with periods when unions are negotiating new wage agreements or are trying to enforce particular benefits.

The Coal Board's Quarterly Statistical Statement

At the end of last week, the National Coal Board issued its *Statistical Statement on the Costs of Production, Proceeds and Losses of Collieries for the Third Quarter of* 1952. It shows that during that quarter the saleable tonnage of coal from the Board's mines was 49,256,040 tons, of which amount 45,884,937 tons were disposed of commercially, the remainder being required for mine consumption and miners' coal. The total proceeds from the sale of coal during the third quarter of last year were £139,614,659, but production costs amounted to £144,621,725, so that, before charging interest the loss on the quarter's transactions was £5,007,066. The estimated profits from the National Coal Board's ancillary undertakings were £620,000, so that the overall loss was reduced to £4,387,066. Provision of £5,200,000 had been made for taxation—a provision which was eliminated by the trading loss—and the trading account at the end of the quarter therefore showed a balance of £812,934. But provision had to be made for £3,900,000 payable as interest to the Minister of Fuel and Power, which brought the finally estimated deficit on the quarter to £3,087,066.

Dealing with costs of production, the statement shows that wages, including holiday pay and allowances in kind, required the sum of £90,352,042; roof supports, general stores and repairs cost £25,769,815; coal and power consumed cost £7,437,836; and other costs (including depreciation) amounted to £21,062,032. The average cash earnings of miners of all ages during the quarter were as follows: face workers, £11 14s. 9d. a week; all underground workers, £10 14s. 8d. a week; surface workers, £7 19s. 8d. a week; and all workers, £10 2s. 8d. a week. To those figures amounts varying from 7s. 7d. to 8s. 4d. a week are added as the value of allowances in kind. It is pointed out, however, that the rates of cash earnings shown in the statement are inflated to some extent by the inclusion of arrears of wages paid in the East Midlands and South-Western Divisions under national agreements for overmen, deputies and shot-firers, which applied retrospectively to the first full pay week after November 20, 1951. In a general note on the figures the National Coal Board says that the colliery losses in the third quarter of last year included £2,200,000 which related to earlier periods as a result of these new wage agreements and of alterations in selling prices. It is now unlikely that the Board will have to provide for taxation in 1952 and the provisions made in the earlier quarters have therefore been written back.

The Coal Outlook

On Tuesday last, at a luncheon in London, Sir Hubert Houldsworth, chairman of the National Coal Board, reviewed the progress made during 1952 in the coal mining industry, and spoke about the outlook for the present year. He said that weighing up all the factors—increased face room, more trained men and better deployment of manpower—some increase of coal output could be expected in 1953, which would enable home needs to be met and the export trade to be expanded. Sir Hubert did not, however, give any estimate of the increase. He pointed out that, during this year, the miners would be taking a second week's holiday. It was hoped that that would be accompanied by a substantial reduction in absenteeism during the rest of the year, as absenteeism in the weeks immediately following the holidays was higher than ever. Nevertheless, Sir Hubert said, the Board would have to budget for a considerable loss of output through holidays, and would need all the coal that could be obtained from voluntary working on Saturday mornings. Managements would continue their efforts to improve the use made of the additional face workers in the industry, and generally to redeploy the industry's manpower to increase efficiency. In some areas, Sir Hubert explained, men would be required in 1953 only to replace wastage. In all, he considered, the Board would require from 10,000 to 12,000 additional men in the right places.

Index of Industrial Production

The index number of industrial production (1948=100), which is prepared by the Central Statistical Office of the Treasury, has been estimated provisionally at 119 for all industries in October, 1952, compared with 115 in September. The figure for the corresponding months of 1951 was 121 both in October and September. The October 1952 index number for the manufacturing industries only was 120, compared with 125 for a year earlier, while that for mining and quarrying was 116, compared with 113 in October, 1951. The Treasury says that, on the basis of the information which it has so far received, the index for all industries in November, 1952, is expected to be 121 or 122.

The Taxation of Profits

This week, the Engineering Industries Association has issued the text of the pre-Budget representations which it has made to the Chancellor of the Exchequer. In its statement, the Association says that the present tax burden on industrial profits, coupled with restrictions on the availability of capital, represents a "disincentive" to the engineering industry which is having an extremely grave, but hidden, effect upon the volume, efficiency and costs of export production. The Association claims that medium size firms dare not accept orders which involve capital outlay or employment of working capital beyond the capacity of their present financial structure. In brief, its statement says, extra effort will bring anxiety with virtually no extra reward, and may result in financial disaster. The real restrictions on production, the Association asserts, are those of finance rather than shortage of materials.

A suggestion made by the Association is that there should be a three-year budgetary plan whereby reductions in taxation for the coming fiscal year may be used to stimulate export production and provide a higher yield in direct taxation for the ensuing years. It is argued that if a longer budgetary cycle were adopted an opportunity could be taken to adjust a position in which taxes cannot be reduced until production increases, and production cannot expand until taxation eases. As stimulants to the exporting industries, the Association recommends the repeal of the excess profits levy, a reduction of the profits tax, the restoration of initial allowances, and reductions in the standard rate of income tax and in the rate of purchase tax charged on all items entering into production costs by way of overheads.

Common Law Claims and the Employer

Among the lecture courses and conferences being arranged for the near future by the Industrial Welfare Society is one on the subject of "Common Law Claims and the Employer." It is to be a half-day conference and will be held at Robert Hyde House, 48, Bryanston Square, London, W.1, on Tuesday, January 20th, beginning at 2 p.m. Mr. John Stamps, secretary of the Industrial Welfare Society, will preside at the conference, and the principal speakers will be Mr. H. Samuels, who will deal with "The Law Affecting Accidents at Work"; Mr. W. Newell, whose subject is "Experience of Common Law Claims in an Industrial Undertaking," and Mr. C. Gaskin, who will speak on "The Responsibilities of the Safety Officer." The fee for the conference is 10s. 6d. per delegate for member firms of the Society, and 15s. for non-members. Application to attend should be made to the Industrial Welfare Society, 48, Bryanston Square, W.1.

Trade Disputes

According to figures published in the *Ministry of Labour Gazette*, there were in progress in the United Kingdom during the month of November last 143 stoppages of work arising from industrial disputes. Altogether, 47,500 workpeople were affected directly and indirectly by these stoppages and an aggregate loss of 126,000 working days was incurred. Of the total number of stoppages in November, ninety-eight occurred in the coal mining industry, involving 41,000 workpeople and causing a loss of 104,000 working days.

The Ministry of Labour says that 120 stoppages of work through disputes ended in November. Of that number, fifty-five, directly involving 2500 workers, lasted not more than one day; twenty-seven, involving 4300 workers, lasted two days; seventeen, involving 4000 workers, lasted three days; thirteen, involving 4400 workers, lasted from four to six days, and eight stoppages, involving 600 workers, lasted more than six days.

Notes and Memoranda

Air and Water

P. AND O. LINER.—The Peninsular and Oriental Steam Navigation Company announces that the 28,000-ton liner which is under construction for the company at the Belfast yard of Harland and Wolff, Ltd., will be named "Iberia." This was the name of the first vessel ordered by the company to its own requirements and was built on the Thames in 1836.

MINISTRY OF CIVIL AVIATION APPOINTMENT.—The Minister of Civil Aviation has appointed Sir Frederick Brundrett, K.B.E., deputy scientific adviser to the Ministry of Defence, to be honorary scientific adviser to the Ministry of Civil Aviation in place of Sir Robert Watson-Watt, C.B., F.R.S., who has resigned the appointment of chief telecommunications adviser.

FRENCH BUILT DOXFORD ENGINE.—The first Doxford oil engine to be built in France has been completed at the Marseilles works of the Chantiers de Provence. The engine has four cylinders of 600mm diameter by 2320mm combined stroke and on trial developed 4000 b.h.p. on a consumption of 160 grammes per horsepower hour. This unit, which weighs 236 tons and has a length of 34ft 5in by 32ft 2in in height, is to be installed in the oil tanker "Djemila," which the company is building for the Compagnie Navale des Petroles. A second Doxford engine, having three cylinders, is under construction for installation in a collier.

AMERICAN HONOUR TO MR. C. C. WALKER.—Mr. C. C. Walker, C.B.E., A.M.I.C.E., F.R.Ae.S., chief engineer and a founder director of The de Havilland Aircraft Company, Ltd., has been elected the Honorary Foreign Fellow of the Institute of the Aeronautical Sciences of the U.S.A. for the year 1952. The by-laws of the Institute provide for the election of one foreign and one American fellow annually. In his long career Mr. Walker has contributed notable services to the aircraft industry and has served on the councils of the Royal Aeronautical Society and the Society of British Aircraft Constructors; for some years he represented the S.B.A.C. on the Air Registration Board. In 1938 he became a Fellow of University College, London, where he was educated.

NOVEMBER AIR TRAFFIC AT UNITED KINGDOM AND CHANNEL ISLAND AERODROMES.—Air transport movements recorded at United Kingdom aerodromes in November, 1952, totalled 11,550, 4 per cent more than in November, 1951, and passengers handled totalled 169,100, showing an increase of 20 per cent. Freight on and off loaded at 3460 short tons showed an increase of 9 per cent. Post Office mail set down and picked up decreased from 1187 to 1092 short tons. At London Airport there were 2570 air transport movements (an increase of 2 per cent) and passengers handled totalled 54,800 (an increase of 8 per cent). Northolt recorded 2660 transport movements, a decrease of 1 per cent, while passengers handled increased by 13 per cent to 43,800. Airports at which passenger traffic increased considerably over November, 1951, were Prestwick, 10,900 (26 per cent increase); Glasgow (Renfrew), 10,000 (49 per cent increase); Manchester (Ringway), 8100 (62 per cent increase); and Isle of Man (Ronaldsway), 3900 (22 per cent increase). Edinburgh (Turnhouse) passengers increased by 250 per cent to 2300. Jersey Airport handled 6800 passengers, an increase of 16 per cent, and Guernsey 4700, an increase of 13 per cent.

Miscellanea

I.MECH.E. SUMMER MEETING.—The summer meeting of the Institution of Mechanical Engineers is to be held in Sheffield on Wednesday, Thursday and Friday, July 1st, 2nd and 3rd. Further details are to be announced shortly.

REINFORCED PLASTICS TECHNICAL COMMITTEE.—The British Plastics Federation is to form a special technical committee, to be known as the Glass and Asbestos Fibre Reinforced Plastics Technical Committee. It will hold its first meeting at the Federation offices, 47–48, Piccadilly, London, W.1, on Thursday, January 15th.

CHEMICAL ENGINFERING BROCHURE.—We have received from W. J. Fraser and Co., Ltd., a copy of the company's brochure in which the various equipment items manufactured for oil refineries and chemical engineering works, including drying, mixing, evaporation and distillation units, are briefly described and illustrated.

ADEN REFINERY.—The Anglo-Iranian Oil Company, Ltd., has signed the main contract for building the 5,000,000 tons refinery at Little Aden with the Middle East Bechtel Corporation and with George Wimpey and Co., Ltd., for the construction of the oil port. Orders for material and equipment to the value of £5,000,000 have been placed with British manufacturers.

MACKINNON RESEARCH STUDENTSHIP.—The council of the Royal Society has awarded two Mackinnon Research Studentships as follows: to Mr. R. C. Jennison, of Manchester University, to work on radio astronomy at the Jodrell Bank Experimental Station, and to Dr. F. K. Duxbury, of King's College, University of Durham, to work on organic chemistry at Liverpool University.

THE LATE MR. S. H. BUSCH.—We have learned with regret of the death of Mr. S. H. Busch, which occurred in London on Friday last, January 2nd. Mr. Busch, who was in his seventieth year, first came to London, from Sweden, in 1910 and from then until the end of 1946 he was managing director of Asea Electric, Ltd., Walthamstow, E.17. After relinquishing that appointment, he remained as chairman of the company for a further year, when he retired and went to live in Belgium.

THE IRON AND STEEL BILL.—The Minister of Supply, Mr. Duncan Sandys, met representatives of the general council of the T.U.C. and of the principal trade unions in the iron and steel industry on Friday last. The purpose of the meeting, which was held at the invitation of the Minister, was to discuss the provisions of the Iron and Steel Bill. It has since been stated that, whilst it was made clear that the T.U.C. maintained its opposition to the Government's policy of denationalisation, a useful exchange of views took place on various aspects of the Bill and the Minister undertook to consider certain detailed amendments suggested to him by the delegation.

USE OF PRIVATE GENERATING PLANT.—The British Electricity Authority has announced that, as stated by the Minister of Fuel and Power in Parliament on November 24th last, the Electricity Boards intend to implement the recommendation of the Ridley Committee that restrictive conditions embodied in old contracts on the use and installation of private generating plant should be abandoned. Accordingly, if any consumer desires to use private plant, and such use would contravene the provisions of his agreement with the Electricity Board concerned, the Board will be prepared to enter into a new contract which will reflect the costs of connecting and supplying the consumer while leaving him free to use the private plant.

GAS ANALYSIS APPARATUS.—A leaflet has just been published by Griffin and Tatlock, Ltd., Kemble Street, London, W.C.2, describing the "GLC" (Gooderham) soap film gas analysis apparatus it is now manufacturing. The design of the apparatus was evolved by the company and the North Thames Gas Board (formerly Fulham Research Laboratory of the Gas Light and Coke Company). The makers state that with it the average time taken for an analysis of town's gas or other gaseous mixture of similar composition, after an initial period for flushing, is three minutes. The sizes of and graduations on the soap film meters are designed to suit the appropriate gases under test and to give a degree of accuracy within plus or minus 0·1 per cent.

TUBE DATA.—A particularly useful book on tube practice has been issued by Accles and Pollock, Ltd., Oldbury, Birmingham, for the use of designers and users of tubes and tubular parts. This book deals in detail with mill practice and gives a considerable amount of the general information which is often wanted at short notice in design and purchasing departments. The following list of the principal sections of the book gives an impression of the wide field it covers:—General information; steels, analyses and mechanical properties; B.S. 980/1950 cold drawn seamless steel tubes; general engineering chemical composition; aircraft tubes; technical data on rust and corrosion-resisting steels; stainless steel couplings, R/A bends and hypodermic needle tubing; non-ferrous metals; creep-resisting steels; Dayton tools and tapering rolls; properties of carbon steel tubing, and tables of useful general data. The book is a loose-leaf one so that new data sheets and revisions can be easily inserted.

DUMFRIES RADIO TRANSMITTING STATION.—Part of the B.B.C. plan to improve reception of the Home Service programmes in certain areas will include the building of a low-power transmitting station at Mousewald, near Dumfries. As the building and installation will take some time to complete, a temporary transmitter has been installed in a caravan on the site so that listeners in the area may have improved service during the present winter. It radiates the Scottish Home Service on 371m (809 kc/s), operating in the evenings only, from 5 p.m. until the Home Service closes down. The power (500W) is less than that planned for the permanent station, but sufficient to provide improved reception for many listeners in Dumfries and the Nith estuary district. When the permanent station is completed the service area will be extended as far as Lochmaben, Lockerbie and Annan. The temporary transmitter is housed in a standard fourberth caravan, which has been modified to B.B.C. design to accommodate the transmitter and its associated apparatus.

Personal and Business

MR. DAVID HIGGS, B.Sc., has been appointed managing director of Higgs Motors, Ltd., Witton, Birmingham, 6.

THE BRUSH A.B.O.E. GROUP announces the appointment of Mr. Maurice Tattersfield, A.C.A., as group controller of accounts.

MR. RAYMOND P. BROOKES, managing director of Garringtons, Ltd., has been appointed to the board of Guest, Keen and Nettlefolds, Ltd.

MR T. HALL, Mr. E. Hepworth and Mr. A. H. Royle have been appointed directors of the Pioneer Oilsealing and Moulding Company, Ltd.

WILLIAM MILLS, Ltd., Friar Park Road, Wednesbury, states that Mr. Andrew Blyth, general manager, has been appointed a director of the company.

MR. J. H. HUTCHINSON, A.M.I.Mech.E., has succeeded Mr. A. H. A. Bastable as project engineer of The Hymatic Engineering Company, Ltd., Redditch, Worcs.

SIR GEOFFREY BURTON has been elected chairman of Blaw Knox, Ltd., 90—94, Brompton Road, London, S.W.3, in succession to the late Mr. J. Theodore Goddard.

THOMPSON BROTHERS (BILSTON), Ltd., announces that Mr. A. M. Hutcheson, A.M.I.Mech.E., manager of the chemical plant department, has been appointed a director.

OPPERMAN GEARS, Ltd., Newbury, Berks, states that it has appointed Saunders and Purves, Ltd., 12, St. Mary's Place, Newcastle upon Tyne, as sole agents for Northumberland, Durham, Westmoreland, Cumberland and N.E. Yorkshire, and Andrew McNair and Co., 261, West George Street, Glasgow, C.2, as sole agent for Scotland.

EVERSHED AND VIGNOLES, Ltd., Acton Lane Works, Chiswick, W.4, announces the appointment of Mr. H. H. Harper as representative for South Wales and South-West England.

MR. E. A. BROMFIELD has been appointed general secretary of the Association of Supervising Electrical Engineers, 54, Station Road, New Barnet, Herts, in succession to the late Mr. A. Brammer.

MR. GEOFFREY WOODS has been appointed honorary secretary and treasurer of the Fan Manufacturers' Association, the address of which is now Copthall House, Copthall Avenue, London, E.C.2.

VISCOUNT PORTAL OF HUNGERFORD, K.G., has succeeded Mr. R. W. Cooper as chairman of the British Aluminium Company, Ltd. Mr. E. F. O. Gascoigne has been appointed a director of the company.

THE BRISTOL AEROPLANE COMPANY, Ltd., has announced that Mr. William Masterton, C.A., and Dr. Stanley G. Hooker, O.B.E., D.Phil., D.I.C., F.R.Ae.S., have been appointed directors of the company.

MR. A. G. E. BRIGGS has now relinquished his appointment as deputy controller of supplies in the Ministry of Supply and has resumed his full-time duties as joint assistant managing director of Tube Investments, Ltd. (Electrical Division).

MR. C. J. STEWART has been appointed acting manager of the Newcastle upon Tyne office of the Brush Electrical Engineering Company, Ltd., in succession to Mr. M. C. Blythe, who has become sales manager of Brush Electrical (Australia) Pty., Ltd.

TRANSFORMERS (WATFORD), Ltd., is now the title of the company hitherto known as Transformers and Welders, Ltd. The company is a subsidiary of London Brick Company, Ltd. Its head office and works are at Sandown Road, Watford, Herts.

DEWRANCE AND CO., Ltd., states that Mr. R. W. Ogden is relinquishing his post as Birmingham office manager at the end of this month. He is to be succeeded by Mr. A. Brown, Yorkshire area representative. Mr. Brown's successor is Mr. R. E. F. Ellwood.

THE HARLAND ENGINEERING COMPANY, Ltd., announces the retirement of Mr. F. Carleton Anderson, one of its founder directors. Mr. W. Scott and Mr. L. Spiro, both of whom have been in the company's service for many years, have been appointed to the board.

MR. HUGH O. BOURNE has retired from his position as managing director of Maiden and Co., Ltd., Hyde, Cheshire, after forty-two years' service with the company. He will continue as a director. Mr. G. Barrie Tinker has been appointed general manager of the company.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., announces the retirement of Mr. R. S. Gough and Mr. T. R. Thomas, its Bristol and Cardiff branch managers. Mr. T. L. Purves has been appointed branch manager at Bristol, and Mr. L. R. Greet has become branch manager at Cardiff.

HARLAND AND WOLFF, Ltd., Belfast, announces that Mr. T. C. Tobin M.A., the company's naval architect, has retired and that Mr. R. Cameron, B.Sc., has been appointed to succeed him. Another appointment is that of Mr. M. Doig, who succeeds Mr. J. Wilkie as manager of the Victoria Works.

MR. W. A. GREEN, M.I.Mech.E., states that he has taken Mr. G. B. Fox, M.I.Mech.E., into partnership in his consulting practice. The partnership will be known as Green and Fox, and the practice will be carried on from Rowans," Monks Road, Virginia Water, Surrey (telephone, Wentworth 3140).

MR. W. J. MURRAY has retired from the chairmanship of Sharples Centrifuges, Ltd., Woodchester, Stroud, Glos, but will continue as a director. Mr. A. H. Keable, M.I.Mech.E., managing director of the company since 1928, has been appointed chairman and is succeeded as managing director by Mr. G. P. Balfour, A.C.G.I. Mr. G. J. Keady, president of The Sharples Corporation, Philadelphia, has joined the board of the British company.

THE POWER-GAS CORPORATION, Ltd., and Ashmore, Benson, Pease and Co., Stockton-on-Tees, announce the following appointments: Mr. C. E. Wrangham, a director on the main board of The Power-Gas Corporation, Ltd.; Mr. Charles Ingman, director in the technical and contracting division of the companies; Mr. T. K. Hargreaves, A.M.I.Mech.E., director, the companies' works division; Mr. Laurence Davies, secretary of the companies. Mr. C. Robson has relinquished the office of secretary in order to devote himself fully to the duties of commercial director.

THE UNITED STEEL COMPANIES, Ltd., state that Rear-Admiral (E) C. W. Lambert, C.B., general works manager at the Appleby-Frodingham branch, Scunthorpe, will retire at his own request on June 30th next. He will be succeeded by Mr. Albert Jackson, who is at present works manager (steel) and deputy general works manager. Mr. T. P. Lloyd has been appointed assistant works manager (steel) and is to succeed Mr. Jackson as works manager (steel) on July 1st. At the Workington Iron and Steel branch of the United Steel Companies, Ltd., Mr. C. R. Blick has been appointed assistant commercial manager. At the Steel, Peech and Tozer branch, Rotherham, Mr. V. Watkins has been appointed deputy chief engineer and Mr. C. Wilkinson has been appointed cold rolling mill manager.

British Patent Specifications

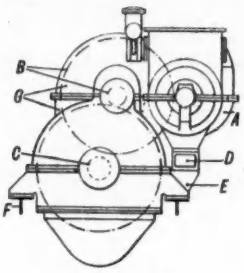
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

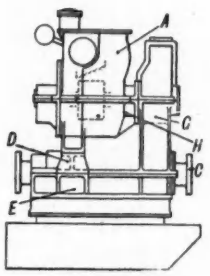
Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. 8d. each.

MARINE ENGINEERING

683,138. December 6, 1949.—PISTON ENGINE WITH EXHAUST STEAM TURBINE, Aktiengesellschaft "Weser," Werftstrasse, 18, Bremen, 13, Germany.

The drawing shows an example of the invention as applied to the propulsion plant of a single-screw ship. The turbine arranged in the housing *A* drives, through the gearing *B*, the shaft *C* which is coupled with the piston engine and the propeller shaft. The housing of the turbine is mounted by means of a front supporting foot *D* on the base plate *E*, which is fastened to girders *F* of the ship's hull. The base plate is at the same time a part of a housing *G* for the gearing. The rear side of the turbine housing is





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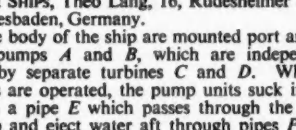
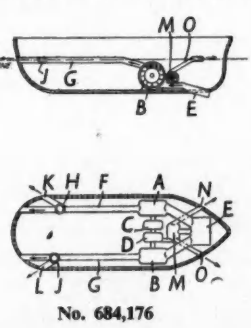
fixed by means of a flange bearing *H* to the gear housing. Instead of using only one front supporting foot, the turbine can be mounted on the base plate by front supporting feet. Between the turbine and the gearing housings there is left sufficient air space to be able, if necessary, to carry out heat insulation.—*November* 26, 1952.

684,176. May 25, 1950.—DRIVING ARRANGEMENT FOR SHIPS, Theo Lang, 16, Rüdesheimer Strasse, Wiesbaden, Germany.

In the body of the ship are mounted port and starboard pumps *A* and *B*, which are independently driven by separate turbines *C* and *D*. When the turbines are operated, the pump units suck in water through a pipe *E* which passes through the hull of the ship and eject water aft through pipes *F* and *G* to drive the ship forwards. When only the turbine *C*





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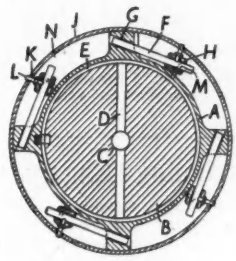
is running, the pump unit *A* will be operated and the ship will swing to port. On the other hand, if only the turbine *D* is running the ship will swing to starboard. To assist in controlling the direction of travel of the ship, slide valves *H* and *J* are provided in the ejection tubes *F* and *G*, the valves being remotely controlled from a control station. Further pipes *K* and *L* are branched off from the ejection pipes and are passed through the side of the ship and through these pipes the water is diverted by the operation of the slide valves and ejected either to port or to starboard. Since the direction of rotation of turbines cannot be changed, a small auxiliary pump unit *M* is connected to the suction pipe *E* and with two ejection pipes *N* and *O* passing through the bow of the ship. For travelling astern, the pump units *A* and *B* are stopped and the ship is driven by means of the auxiliary pump unit *M*. For steering during travel astern, valves similar to the valves *H* and *J* are provided in the pipes *N* and *O*.—*December* 10, 1952.

PRIME MOVERS

683,134. October 24, 1949. — CENTRIFUGAL GOVERNORS FOR ENGINES, Cockburns, Ltd., James Rodger and Thomas Grant, all of the company's address at Clydesdale Engineering Works, Cardonald, Glasgow, S.W.2.

The drawing shows a section through the centre of the governor on a plane normal to the axis of the engine shaft. *A* is a foundation ring member clamped to a shaft *B*, which latter is formed with an axial passage *C*, radial passages *D*, and a circumferential groove *E*, all in communication. Spring bar members *F* are mounted in sockets *G* formed in radial projections of the foundation ring member *A*. The bar members carry weights *H*. A peripheral ring *J* formed with holes *K* is engaged by pins *L* on the weights. *M* is one of two ports in communication with the groove *E*. In practice, fluid under pressure is



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admitted to the passage *C*. As the shaft rotates the foundation ring member rotates with it and centrifugal action urges the weights *H* to move away from the shaft, thereby flexing the bars *F*. Movement of the weights in relation to the ports *M* causes these ports to be more or less unmasked to vary the rate of escape of fluid from the passage *C* through the ports into the annular chamber *N* to vary the pressure of the fluid in the passages *C*, *D* and the groove *E*. Variation in the pressure of the fluid causes the control to operate and control the operation of the engine. Fluid in the chamber *N* is returned for re-use. The operating range of the governor may be varied by rotating the peripheral ring *J* relatively to the foundation ring member, the weights *H* being thus moved relatively to the foundation ring and the spring bar members being caused to slide into or out of their sockets to vary the effective free length of the spring bar members *F* and their amount of deflection for a given rotational speed.—*November* 26, 1952.

MINING ENGINEERING

683,356. January 26, 1951.—MINE PROPS, De Directie van de Staatsmijnen in Limburg, 2, van der Maesenstraat, Heerlen, Netherlands, a Dutch Government Department.

The drawing shows the base end of a prop and its base plate; the same general construction is suitable for the head and head plate of a prop. The base plate *A* is provided with a central part-spherical projection *B*, on which the concaved end *C* of the prop *D* rests. The underside of the base plate has a central recess *E*, which is surrounded by an annular ridge *F* extending axially beyond the general plane of the bearing surface *G*. When the prop is loaded the ridge *F* is pressed into the floor, while also the entire base plate will penetrate somewhat into the floor and material

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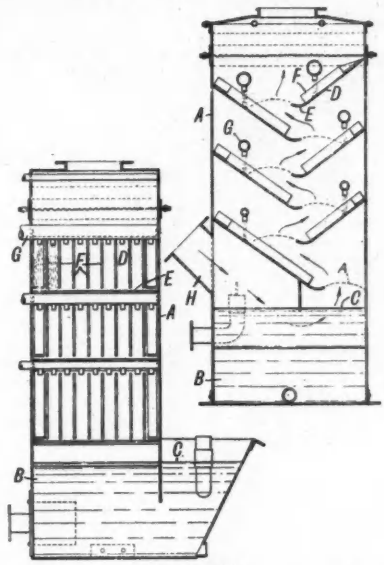
of the latter will rise into the recess *E*. If now a lateral force is exerted on the lower end of the prop, the base plate will strongly resist displacement along the floor by reason of the ridge *F*. If lateral movement of the roof displaces the head of the prop the ball and socket joint between the base plate and the lower end of the prop enables these two parts to hinge with respect to each other, the line of action of the reactional force still coinciding or substantially coinciding with the longitudinal axis of the prop. When the prop is being withdrawn, the loose base plate may be buried under falling rock. For this reason, the base plate is provided with a chain by which it can be drawn from beneath the rock. By bevelling the circumference of the bearing surface at *J* and by slightly tapering the ridge *F* an embedded base plate will be loosened more easily. Another advantage of a bevelled edge as applied to a head plate is that there is reduced tendency for the plate to crack the roof with consequent loosening and falling of pieces of rock.—*November* 26, 1952.

MISCELLANEOUS

683,988. October 6, 1950.—WASHING APPARATUS FOR THE SEPARATION OF FINE PARTICLES FROM GASES, Walter Fritz Mode, 38, Tilehurst Road, Cheam, Surrey.

As the drawing indicates, the apparatus comprises a rectangular casing *A* having its lower part constructed as a tank *B* for washing liquid, the normal level of which is indicated at *C*. An overflow for maintaining this level constant is provided. Within



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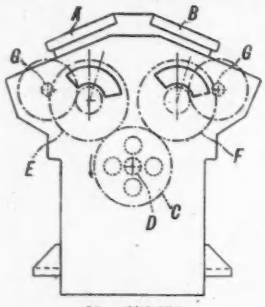
the main casing are two series of inclined baffles *D*, each series extending inwards and downwards from one of two opposite walls of the casing. The baffles of one series are arranged in vertically spaced overlapping relation to the corresponding baffles of the other series. Each baffle comprises a flat metal plate having its inner and lower marginal portion curved upwards to form a shallow trough *E*, the free edge of which is in the same horizontal plane as the line along which the trough portion joins the flat portion. Upon the upper surface of each baffle are several parallel thin metal strips *F* which are set on edge a small distance apart and arranged along the baffle in the direction to be followed by washing liquid delivered from a supply pipe *G* above. The strips terminate at their lower ends at the lower edge of the flat portion of the baffle. Each supply pipe is provided with a series of branch pipes, each of which is arranged to deliver a solid jet of washing liquid down on to the base of the channel. The pipes *G* decrease in diameter from the top to the bottom because the washing liquid discharged from an upper baffle is received on the next lower baffle and the requisite flow of liquid from the lower edge of the latter may therefore be ensured with a reduced supply of liquid. The gas to be cleaned is admitted to the interior of the casing by way of a downward inclined duct *H* and travels in a path indicated by the arrows.—*December* 10, 1952.

INTERNAL COMBUSTION ENGINES

684,101, February 3, 1950.—THE CONSTRUCTION OF INTERNAL COMBUSTION ENGINES, Davey Paxman and Co., Ltd., Standard Ironworks, Colchester, Essex (*Inventer: Albert George Howe*).

The invention is shown as applied to a multi-cylinder diesel engine having two inclined banks *A* and *B* of four cylinders each, balancing being effected by utilising, first, the gear trains through which the camshafts are driven at half speed from the crankshaft. A gear wheel *C* on the crankshaft *D* is arranged to drive at crankshaft speed two intermediate gear wheels *E* and *F*, each forming part of the drive to one of the camshafts *G* and each formed with a segmental balance weight so arranged as, during operation,

to set up a couple to counterbalance the couple set up by the operation of the moving parts on the crankshaft. Alternatively, the invention may be carried into effect by the employment of a single gear wheel carrying a balance weight and driven, as before at crankshaft speed, from a gear wheel on the crankshaft.



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This single weighted gear wheel meshes with two other gear wheels through which the drive is transmitted to the two timed camshafts. The invention is also applicable to engines wherein only one camshaft is used, by including a weighted wheel in the camshaft driving train.—*December* 10, 1952.

Codes of Practice

TELEPHONES AND TELEGRAPHS—PUBLIC SERVICES. TELEPHONES AND TELEGRAPHS—PRIVATE SERVICES

The Council for Codes of Practice for Buildings has now issued in final form Code 327,101, "Telephones and Telegraphs—Public Services," and Code 327,102, "Telephones and Telegraphs—Private Services." Drawn up by a committee convened on behalf of the Council by the Institution of Electrical Engineers, the present codes are revisions of drafts previously issued for comment.

The code dealing with public services describes the principal telephone and telegraph systems supplied and/or maintained by the Post Office to provide intercommunication within a building or group of buildings, and between remote buildings via the public telephone or telegraph services or via private circuits supplied by the Post Office. Advice is given on the necessary consultation at the planning stage and on the telephones and telegraph facilities available. Ten diagrams of telephone extension plans are included. Power supplies, methods of wiring and provision of the necessary structural accommodation for the equipment and wiring are dealt with. A section on maintenance is included.

The code dealing with private services describes telephone and telegraph systems other than those connected to the public system or supplied by the Post Office. Advice is given on the necessary consultation at the planning stage and on the choice of materials, appliances and components. Particulars are given of telephone and teleprinter equipment and facilities available, and internal and external wiring, including underground cables, are dealt with. Recommendations are made for power supplies and for the provision of the necessary structural accommodation and an appendix deals with segregation of power and telecommunication circuits.

Copies of the codes, which carry the usual warning that, in the present abnormal conditions, it may not be practicable to carry out all the recommendations, can be obtained from the British Standards Institution, 24/28, Victoria Street, London, S.W.1, price 7s. 6d., each post free.

Launches and Trial Trips

BLANDFORD, oil tanker; built by Harland and Wolff, Ltd., for the Blandford Shipping Company, Ltd.; length between perpendiculars 531ft, breadth moulded 74ft, depth moulded 38ft 3in, dead weight 18,500 tons; two 75kW steam-driven and one 75kW diesel-driven generators; Harland-B. and W. opposed-piston diesel engine, seven cylinders, 750mm diameter by 2000mm combined stroke, 113 r.p.m., two single-ended cylindrical, multi-tubular boilers. Launch, December 18th.

NESSBANK, cargo liner; built by Harland and Wolff, Ltd., for the Andrew Weir Shipping and Trading Company, Ltd.; length between perpendiculars 425ft, breadth moulded 59ft, depth moulded to shelter deck 38ft 3in, gross tonnage 5800; three 175kW diesel-driven generators; Harland-B. and W. two-stroke, single-acting, opposed-piston diesel engine, six cylinders, 620mm diameter by 1870mm combined stroke. Launch, December 18th.

MASTER NICOS, cargo liner; built by The Burntisland Shipbuilding Company, Ltd., for Motores Maritimos Compania Limitada, Costa Rica; length between perpendiculars 435ft, breadth moulded 62ft, depth moulded to shelter deck 38ft 3in deadweight 12,550 tons, draught loaded 29ft; five cargo holds, derricks complement includes two to lift 25 tons each, steam deck machinery; one cylindrical and one boiler, one Sulzer two-stroke, single-acting diesel engine, six cylinders 720mm diameter by 1250mm stroke, 3940 b.h.p. at 121 r.p.m.; two 40kW steam-driven generators, one 10kW diesel-driven generator.

CHINKOA, cargo liner; built by Barclay Curle and Co., Ltd., for the British India Steam Navigation Company, Ltd.; length 485ft, breadth 62ft 6in, depth to shelter deck 40ft 9in, gross tonnage 9000, five holds, derricks include one 20 ton and one 30 ton; twelve passengers; Barclay-Curle-Doxford oil engine, six cylinders, 670mm diameter by 2320mm combined stroke, 6800 b.h.p. at 116 r.p.m.; two cylindrical multi-tubular boilers. Trial, December 19th.

Contracts

BRITISH RAILWAYS (London Midland Region) announces that the following contracts have been placed:—Peter Lind and Co., Ltd., for the construction of a reinforced concrete barrel vault shell roof at Waterloo Dock goods station, Liverpool; the British Challenge Glazing Company, Ltd., for the renewal of the roof with patent roof glazing at Liverpool, Park Lane, Cotton Quay; Arundel and Co. (Louth), Ltd., for the cleaning and painting of Kegworth, Hathern, Syston, Sileby, Barrow-on-Soar, and Humberstone Road passenger and goods stations, and signalboxes from Trent to Leicester; Bagguley and Barker, Ltd., for the drainage stabilisation of cutting slope and construction of new retaining wall on the up slow line between 88 miles 1507 yards and 88 miles 1667 yards on the Rugby to Crewe line; Shephard Hill and Co., Ltd., for the drainage and stabilisation of the cutting slope at Bushey milepost, 15 miles 852 yards on the Euston-Watford electric line; Jerram and Co., Ltd., for central heating in the carriage and wagon repair shops at Toton, and John Wilson and Sons (Contractors), Ltd., for the reconstruction and widening of Bridge No. 5 carrying road A.5 over the railway between Hednesford and Pelsall for the Ministry of Transport.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on or before the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

To-day, Jan. 9th.—CREWE BRANCH: Royal Hotel, Nantwich Road, Crewe, "Small Transformer Design," C. N. W. Reece, 7.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Wed., Jan. 14th.—N.E. SECTION: Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle upon Tyne, "Hearing Aids," R. A. Bull, 6 p.m.

Thurs., Jan. 15th.—MERSEYSIDE SECTION: Electricity Service Centre, Whitechapel, Liverpool, "Design and Application of Quartz Crystals," R. A. Spears, 7 p.m.

ENGINEER BUYERS AND REPRESENTATIVES ASSOCIATION

Fri., Jan. 16th.—LONDON AND HOME COUNTIES BRANCH: "The Cranbourne," Upper St. Martins Lane, W.C.2, Film, "Monte Carlo Rally," 7 p.m.

ILLUMINATING ENGINEERING SOCIETY

Mon., Jan. 12th.—SHEFFIELD CENTRE: Medical Library, The University, Western Bank, Sheffield, Presidential Address, W. J. Wellwood Ferguson, 6.30 p.m.

Tues., Jan. 13th.—LONDON SESSIONAL MEETING: Lighting Service Bureau, 2, Savoy Hill, W.C.2, "Power Station Lighting," P. D. Figgis, 6 p.m.

Wed., Jan. 14th.—HUDDERSFIELD GROUP: Electricity Showroom, Market Street, Huddersfield, "New Applications of Fluorescent Lamps, including Stage Lighting," J. W. Strange, 7.15 p.m.

Thurs., Jan. 15th.—GLOUCESTER AND CHELTENHAM CENTRE: The General Electric Company, Ltd., 2, St. Aldate Street, Gloucester, "Electric Organisms and Living Light," J. Ashmore, 6.15 p.m.

INCORPORATED PLANT ENGINEERS

Mon., Jan. 12th.—DUNDEE BRANCH: Mathers Hotel, Dundee, "Electricity in the Textile Industry," J. O. Campbell, 7.30 p.m.

Tues., Jan. 13th.—E. LANCASHIRE BRANCH: Engineers' Club, Albert Square, Manchester, Open Meeting, Questions Invited, 7.15 p.m.

Wed., Jan. 14th.—E. MIDLANDS BRANCH: Welbeck Hotel, Nottingham, "Peak Steam Demands and Thermal Storage," E. G. Ritchie, 7 p.m.

Thurs., Jan. 15th.—BLACKBURN BRANCH: Chamber of Commerce, Richmond Terrace, Blackburn, "Induction Generation by Back-pressure Equipment," 7.30 p.m.

Fri., Jan. 16th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, Contractors' Plant Discussion Group, 7.30 p.m.

INSTITUTE OF ECONOMIC ENGINEERING

To-day, Jan. 9th.—Cowdray Hall Henrietta Place, Cavendish Square, London, W.1, "Work Study as a Means of Improving Industrial Efficiency," R. M. Currie, 7 p.m.

Sat., Jan. 10th.—The Christian Institute, 70, Bothwell Street, Glasgow, "Estimating," J. McKinnon, 10.30 a.m.

INSTITUTE OF INDUSTRIAL SUPERVISORS

Thurs., Jan. 15th.—LONDON S.E. SECTION: The Polytechnic, Woolwich, Annual General Meeting and Industrial Film Show, 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS

Tues., Jan. 13th.—85, Minories, London, E.C.3, "Some Operating Experiences with Two-Stroke Cycle Engines on Boiler Oil and the Development of Fuel Injection Equipment," A. G. Arnold, 5.30 p.m.

INSTITUTE OF NAVIGATION

Fri., Jan. 16th.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, "Radar and Ice," L. S. Le Page and A. L. P. Milwright, 5 p.m.

INSTITUTE OF PETROLEUM

Wed., Jan. 14th.—26, Portland Place, London, W.1, "Methods of Hydrocarbon Type Analysis" H. C. Rampton, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

To-day, Jan. 9th.—S. WALES GROUP: S. Wales Institute of Engineers, Park Place, Cardiff, "Some Factors Influencing the Choice of a Crankcase Lubricating Oil," A. Towle.

Mon., Jan. 12th.—SCOTTISH CENTRE: North British Hotel, Edinburgh, "The Application of Rubber Bonding to Commercial Vehicles," A. J. Hirst, 7.30 p.m.

Tues., Jan. 13th.—MIDLANDS CENTRE: Crown Inn, Broad Street, Birmingham, "The Application of Synthetic Resin Adhesives in the Road Transport Industry," T. Maxwell Hudson, 7.30 p.m.

Thurs., Jan. 15th.—YORKSHIRE CENTRE: Hotel Metropole, Leeds, "The Development of a Flat-Four Passenger Car Engine," C. G. Grangefield, 7.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS

Tues., Jan. 13th.—The Great Hall, Caxton Hall, Caxton Street, Westminster, London, S.W.1, Symposium on Bursting Discs, Afternoon Session, 3 p.m.-5 p.m., Evening Session, 6 p.m.-8.30 p.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., Jan. 13th.—PUBLIC HEALTH MEETING: Great George Street, Westminster, London, S.W.1, "The Storage, Collection and Disposal of Refuse," J. C. Dawes, 5.30 p.m.

Thurs., Jan. 15th.—N.W. ASSOCIATION: The Council Chamber, Town Hall, Chester, "Some Civil Engineering Aspects of Railway Electrification," D. W. Blower, 6.30 p.m.

Tues., Jan. 20th.—ORDINARY MEETING: Great George Street, Westminster, London, S.W.1, "Claerwen Dam: Design and Construction of a 200ft High Gravity Dam for Birmingham Water Department," P. A. Scott, R. J. C. Walton, R. H. Falkiner and H. D. Morgan, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Jan. 12th.—LONDON STUDENTS' SECTION: Savoy Place, London, W.C.2, Film Evening, 7 p.m.

Wed., Jan. 14th.—RADIO SECTION: Savoy Place, London, W.C.2, "Printed and Potted Electronic Circuits," G. W. A. Dummer and D. L. Johnston, 5.30 p.m.

Mon., Jan. 19th.—INFORMAL MEETING: Savoy Place, London, W.C.2, Discussion on "The Parallel Running of Private Generating Plant with the Grid System," opened by E. R. Wilkinson, 5.30 p.m.

INSTITUTION OF ENGINEERING INSPECTION

Wed., Jan. 14th.—Leeds Church Institute, Albion Place, Leeds, 1, Film Show, 7.30 p.m.

Thurs., Jan. 15th.—George Hotel, Wolverhampton, Discussion Group, 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS

Wed., Jan. 14th.—Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, "Limitations of Acceleration and Braking with Electric Traction," A. S. Robertson, 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Jan. 9th.—THOMAS LOWE GRAY LECTURE: Storey's Gate, St. James's Park, London, S.W.1, "Welding in Marine Engineering," H. N. Pemberton, 5.30 p.m.

Tues., Jan. 13th.—AUTOMOBILE DIVISION: Storey's Gate, St. James's Park, London, S.W.1, Discussion on "Life Assessment Tests for Commercial Vehicles," John Alden, 5.30 p.m.

Wed., Jan. 14th.—E. MIDLANDS BRANCH: County Technical College, Newark-on-Trent, "The Mechanism of Work-hardening in Metals," N. F. Mott, 7.30 p.m.——E. MIDLANDS GRADUATES SECTION: Prince Charlie Room, Art Gallery, Derby, "The Mechanical Properties of Rubber," M. McCallion, 7.15 p.m.

Thurs., Jan. 15th.—N.W. BRANCH: Engineers' Club, Albert Square, Manchester, "Incentives in Engineering," R. J. Gigli, 6.45 p.m.

Fri., Jan. 16th.—Storey's Gate, St. James's Park, London, S.W.1, Discussion on "Control Valves for Direct-hydraulic Presses," F. H. Towler and J. M. Towler, 5.30 p.m.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

Wed., Jan. 14th.—INFORMAL MEETINGS: Conference Room Fourth Floor, Waterloo Bridge House, London, S.E.1, "Telephone Call Office Maintenance," H. C. L. Grafton, 5 p.m.

INSTITUTION OF SANITARY ENGINEERS

Tues., Jan. 13th.—Caxton Hall, London, S.W.1, "Water-proofing of Concrete Structures" Isaac Hopkins, 6 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Tues., Jan. 13th.—LANCASHIRE AND CHESHIRE BRANCH: College of Technology, Liverpool, "Continuous Welded Structures, Abbey Works, Port Talbot," W. R. Atkins, 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Jan. 9th.—ORDINARY MEETING: Townsend House, Greycoat Place, London, W.1, "Automatic Feed Pressworking," C. H. Crawford, 7 p.m.

Mon., Jan. 12th.—N.W. SECTION: Geographical Society, 16, St. Mary's Parsonage, Manchester, Chairman's Address, F. E. Bancroft, 7 p.m.——SHEFFIELD AND DISTRICT SECTION: Livesey Clegg House, Sheffield, "Science Looks at Works Corrosion," H. G. Gow, 7.30 p.m.

Fri., Jan. 16th.—Townsend House, Greycoat Place, London, S.W.1, "Statistics for Practical Engineers," S. J. Button.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

To-day, Jan. 9th.—Mining Institute, Neville Hall, Newcastle upon Tyne, "Some Further Applications of the Moment Distribution Method of Analysis to the Transverse Strength of Ships," H. J. Adams, 6.15 p.m.

OLD CENTRALIANS

Wed., Jan. 14th.—Chez Auguste Restaurant, 47, Frith Street, London, W.1, "Atomic Energy," T. E. Allibone, 12.55 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Thurs., Jan. 15th.—ROAD AND BUILDING MATERIALS GROUP: Building Centre, Store Street, Tottenham Court Road, London, W.1, "The Use of Rubber in Bituminous Road Surfaces," A. R. Smee and L. Mullins, 6p.m.